AGRICULTURAL ENGINEERING

OCTOBER • 1956

In this Issue . . .

Low Section Height Oversize Tractor Tires
Preferred in ASAE Recommendation

•

Hood Inlet for Closed Conduit and Culverts
Displays Surprising Characteristics

•

New Approach to Measuring Operator Comfort
in Tractor and Implement Seats

•

Soil Compaction Determined in Relationship
with Pressure Application

•

Analysis of Soil Preparation Methods
for Meadow Crop Production

ASAE Winter Meeting • Chicago, Ill., December 9 to 12

THE JOURNAL OF THE
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

![BCA]

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BCA pioneered the use of pre-lubricated package unit ball bearings for agricultural implements . . . can help you reduce manufacturing costs and improve implement performance.

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Pioneers of pre-lubricated *package unit* ball bearings for agriculture

AGRICULTURAL ENGINEERING

Established 1920

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JAMES BASSELMAN,
Editor and Publisher

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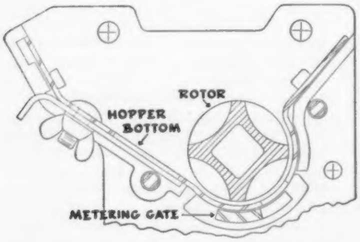
Why Armco Stainless Pays Off in Fertilizer Applicators

Armco Stainless Steel in vital parts on fertilizer applicators assures long, trouble-free service life.

Today's mechanized farming demands long and dependable service from mechanical equipment. This is why agricultural engineers are changing specifications to stainless steel for vital parts exposed to highly corrosive and abrasive conditions.

Take fertilizer hoppers, for example. Carbon steel offers little or no resistance to corrosive attacks from fertilizer chemicals. Paint doesn't hold up under the abrasive action of dry fertilizer. So corrosion on discharge mechanisms and hopper bottoms can destroy the carefully calculated delivery rates of valuable plant foods. In addition, corrosion causes costly delays and premature replacement of parts.



Here's where Armco 12 (Type 410) Stainless Steel gives dry fertilizer applicators assurance of top performance.

STAINLESS SCORES HIGH IN ACTUAL SERVICE

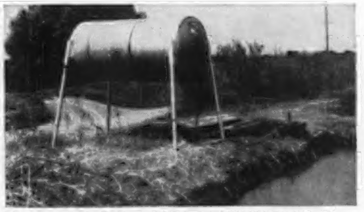
Here's what one manufacturer had to say about Armco 12 (Type 410) Stainless Steel as a solution to the problems of corrosion and abrasion:

"Our engineering department decided to use stainless in these parts for several reasons—long life combined with accurate delivery rates. It is absolutely necessary that the rotor flutes and metering-gate openings remain free of corrosion from the effects of fertilizer chemicals so they do not afford a foothold on which fertilizer can begin caking or clogging. From our applicators in the field, we find that these stainless parts are performing very satisfactorily."

FOR LIQUID FERTILIZER TOO

In the far west where liquid fertilizer is distributed via irrigation water, one manufacturer found the solution to his corrosion problem in tanks made of Armco 18-12 Mo ELC (Type 316L) Stainless Steel. These tanks are used as containers for technical green phosphoric acid and ammonium nitrate solutions.

The tank manufacturer pointed out that this Armco-developed grade of stainless steel "withstands the corrosion of both types of chemicals." He added that no other metal or coating on metal will do this satisfactorily and still be practical economically.



Liquid fertilizer tanks made of Armco 18-12 Mo ELC (Type 316L) Stainless Steel resist severely corrosive chemicals.

STAINLESS CAN HELP YOU

If you have corrosion problems in your fertilizer equipment, consider changing to Armco Stainless Steel for vital parts. Armco produces a wide variety of standard stainless steel grades, in addition to special grades in sheet, strip, bar, and wire. Armco engineers will be glad to work with you in determining the right grade to use. Just fill in and mail the coupon on this page.

ARMCO STEEL CORPORATION
1486 Curtis Street, Middletown, Ohio

Send me your catalog on "Armco Stainless Steels"

We design______

Name______

Company______

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ARMCO STEEL CORPORATION

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Up a Tree on Chain Selections?

No need to be! Consult your CHAIN Belt Man. He has a lot of new data at his finger tips . . . new developments in agricultural chains, attachments and sprockets. Some of these new ideas and products can get you back on the ground . . . help you design your equipment for lower cost . . . better performance.

CHAIN Belt agricultural engineers have been doing a lot of work on implement chains . . . working out stronger, better, lower cost chains. Be sure you have all the data when you start work on a new model or improve a present one.

Call your local CHAIN Belt Man or write CHAIN Belt Company, 4680 W. Greenfield Ave., Milwaukee 1, Wis., for your copy of Agricultural Chain Catalog No. 54-54. Our engineers will be happy to discuss your chain selection and application problems with you.

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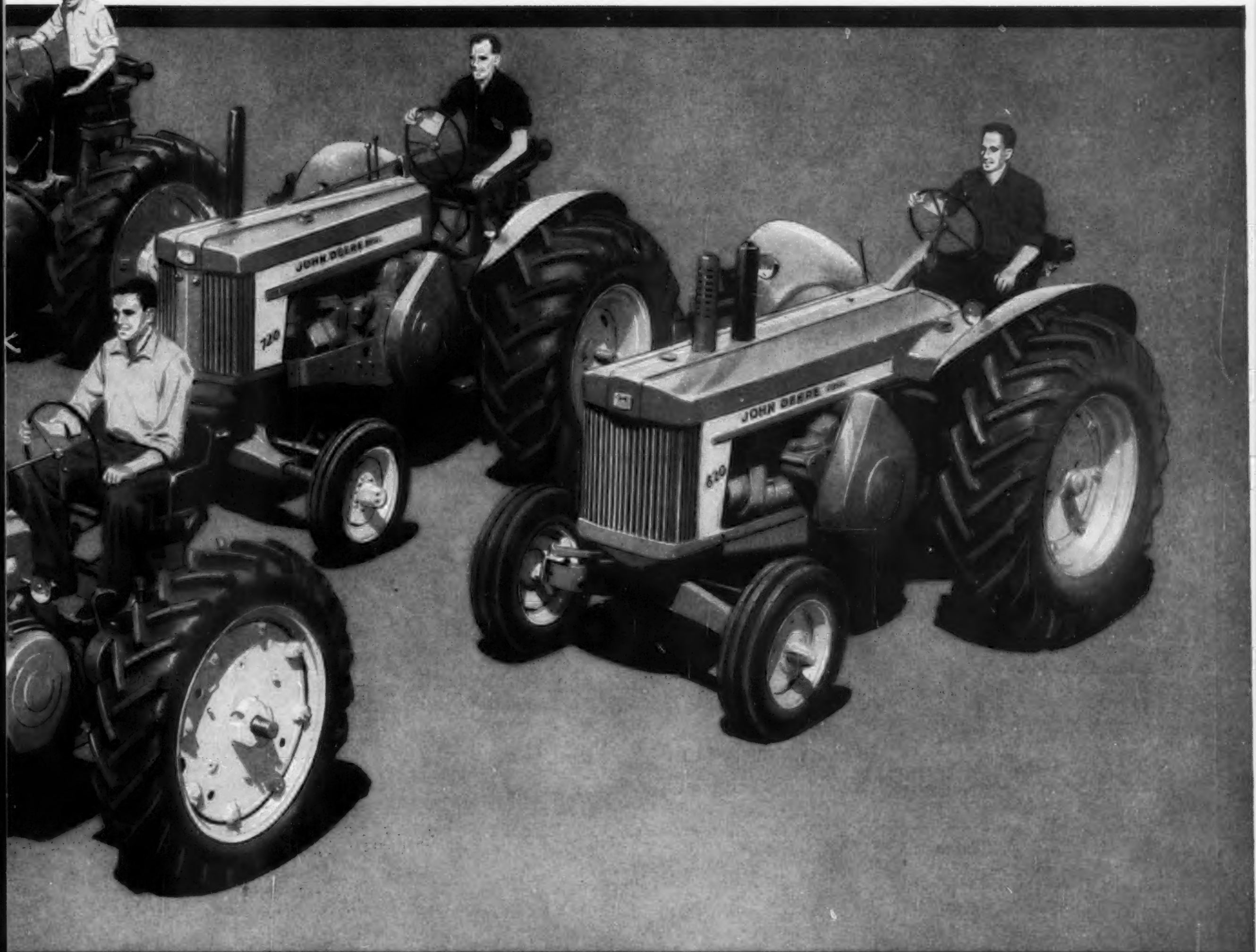
District Sales Offices in all principal cities

for 1957 with 6 Power Sizes • 30 Basic Models



The proof mounts and the news travels! John Deere's new tractor line has put peak earning power on the farms of North America—with higher-than-ever standards for work output and ease of handling.

Every day, more farmers, everywhere, are seeing these new tractors, driving them, and agreeing—with confidence and enthusiasm: "John Deere leads the way for 1957. It's the tractor for me!"

That's logical. No detail was overlooked in designing and engineering these pace-setters of modern farm production power. All-new engines—far more powerful, yet dependable and economical as always. Efficient hydraulic systems—more widely adaptable, with more muscle-saving capacity than ever before. Comfortable seats, handy controls, easy steering. Everything brought together for greater earning power and unmatched ease of operation—plus modern appearance and traditional John Deere quality.

On Main Street, at line fences, after church—wherever farmers meet, the news is spreading fast: "America's newest tractor family is really going to town!"

JOHN DEERE

JOHN DEERE
MOLINE, ILL.

"Wherever Crops Grow, There's a Growing Demand for John Deere Equipment."

Ford Equips New "250"

Dayton BSI* V-Belts Used For Rugged Plunger Drive

In 1954 Engineers at Ford Motor Company, Tractor and Implement Division, were in the final stages of development on a new baler—the "250"—especially designed for the farmer with small hay acreages. Equipped with a 15 hp motor and capable of baling up to 7 tph under average conditions, it was excellent for the farmer who needed a compact, maneuverable unit and didn't want to depend on a custom operator.

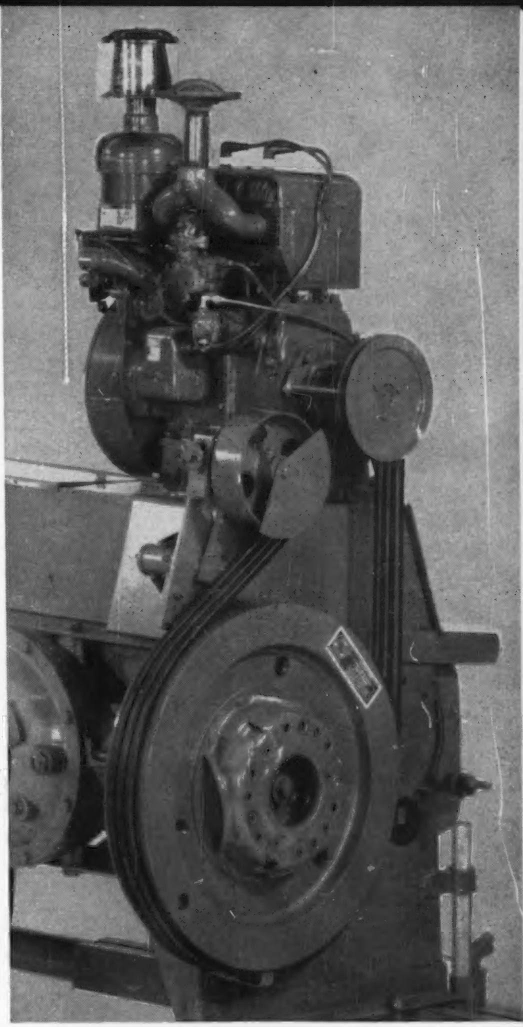
One innovation on the "250" is the use of V-Belts rather than flat belts for power transmission. Tests showed that heavy belt-stretching pulsation was set up by the baler plunger operating at 68 strokes per minute. In order to provide maximum uniform power and to forestall frequent replacement, Ford engineers decided to use V-Belts with minimum stretch characteristics.

Dayton V-Belt Engineers were among those consulted by Ford. They were asked to recommend a low stretch belt which would also take a terrific backbend.

Ford engineers had designed a spring idler to act as a clutch on the V-Belt so baling could be stopped without shutting off the engine. To accommodate the idler the V-Belts had to withstand a brutal backbend as well as possess superior forward flexibility to get maximum "wrap" around the comparatively small engine sheaves.

*Back Side Idler

Three Dayton HB section BSI V-Belts combine strength and two-way flexibility in this installation on Ford's "250" Baler. They transmit a maximum, uniform flow of power from the 15 hp air-cooled engine to the flywheel. Minimum stretch characteristics built into multiple-ply V-Belt helps a spring idler keep the three belts at proper tension at all times. The idler also acts as a clutch. A fly-wheel slip clutch, one of the outstanding Ford features, protects gears, connecting rod and plunger from damage due to overloading while baling.



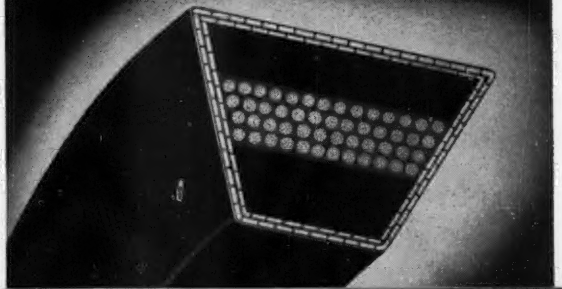
Baler with V-Belts

DAYTON ENGINEERS RECOMMENDED the use of three Dayton Multiple-ply BSI V-Belts to develop the same power as the original flat belt and to beat the problem of pulsating load and two-way flexibility.

Dayton Back Side Idler V-Belts (shown below) are built specifically to withstand the stresses of reverse bending. Their special construction gives them the minimum stretch characteristics needed to resist pulsation.

FORD ENGINEERS accepted the multiple-ply BSI V-Belts after the severest of laboratory and field tests. They are now in use on "250" Balers all over the country.

In every case where you need V-Belts with minimum stretch characteristics, or for any V-Belt problem, contact your Dayton Agricultural Sales Engineer . . . or write Dayton Rubber Co., Agricultural O.E.M. Division, 1500 S. Western Ave., Chicago, Ill.



Dayton Rubber

51 YEARS OF PROGRESS

First in Agricultural V-Belts

Agricultural Sales Engineers in Atlanta, Chicago, Cleveland, Dayton, Moline, New York, San Francisco and St. Louis

Case "400" Tractor and Case 11'6" S wheel harrow with Crucible LaBelle discs.

it's the steel that makes *LaBelle* discs better!

It's a special kind of steel! It's different in a way from the tool, stainless or any of the other hundreds of special purpose steels Crucible produces. But, like them all, it is made expressly for its particular job.

Crucible formulates it with its end use in mind . . . gives it the precise combination of hardness and toughness required for the type of soil it will operate in . . . and grinds it prior to heat treating to insure a longer lasting edge despite highly erosive soil conditions.

Specify LaBelle discs. They're made for all makes of plows and harrows . . . and soil conditions.
Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.

CRUCIBLE first name in special purpose steels

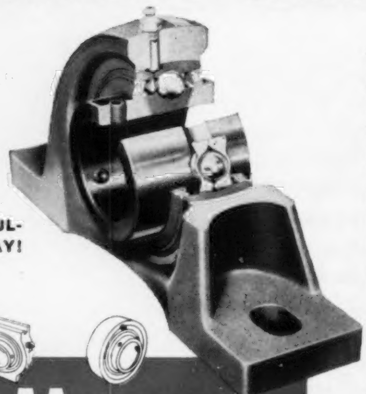
Crucible Steel Company of America

Quality that leads to customer satisfaction and repeat sales

SEALMASTER

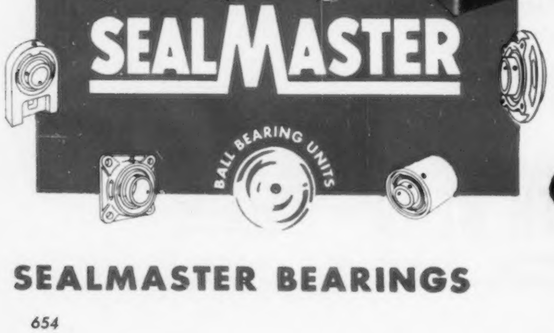
BALL BEARING UNITS

WRITE FOR BULLETIN 454 TODAY!



Today's competitive farm situation has brought about a greater demand for quality by the farmer in every dollar he spends. "Downtime" is as costly to the farmer as it is to industry. Experience has convinced him there is no substitute for quality and it is he who pays the price for "something just as good" through costly breakdowns, usually at the most critical times. Despite the progress made in farm equipment over the years, many machinery manufacturers still fail to take advantage of the benefits of quality anti-friction, self-aligning and pre-lubricated bearings. Shafts still turn in inadequate anti-friction or even simple sleeve bearings, resulting in inefficient power transmission and making it easy for dust and dirt to cause complete breakdowns.

SEALMASTER Ball Bearing Units with their exclusive combination of features offer the farm machinery manufacturer and the farmer trouble-free performance and long life for farm equipment — even under the most severe field conditions.



SEALMASTER BEARINGS

for the farmers and ranchers in your area:

TIPS ON BETTER FARM FENCING

No. 4

FROM UNITED STATES STEEL

1 Corner (or End) Construction

(Your Fence construction will be unhampered and easier if the proposed fence row is cleared of all brush and weeds before actual construction begins.)

Drawing is a double span, horizontal brace design and can be used for either 47" woven wire topped by one strand of barbed wire (suitable for cattle, hogs and sheep) or 39", 32" or 26" woven wire, with the desired number of strands of barbed wire. The table below shows recommended dimensions for posts and braces:

(All posts should be pressure-creosoted wood.)

	Dia.	Length
End or Corner Post	5"-6"	8'
1st Brace Post	4"-5"	8'
2nd Brace Post	3½"-4"	8'
1st Horizontal Brace	3½"-4"*	8'*
2nd Horizontal Brace	3½"-4"*	8'*

Brace Wires: 4 strands of 9 gage galvanized wire.

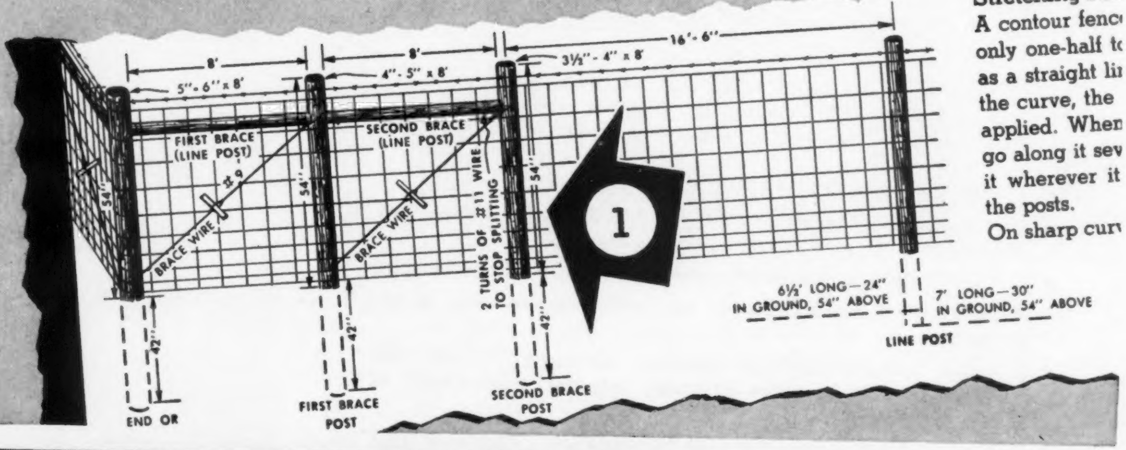
**Although 8' horizontal braces should be used, 6', 6½', or 7' standard line posts will do a good job in end or corner construction. In this case, reduce brace post spacing to accommodate shorter braces.*

A better method than cutting notches in posts to receive horizontal braces consists of dowel pin construction. Use a ¼" or ⅜" x 4" steel rod. Bore posts and braces each about 2" deep to receive the pins. Use same size bit as rod. To keep ends of braces from possible splitting after steel pins have been inserted, wrap them tightly with several turns of 11 gage smooth wire.

Wherever pressure-creosoted wood ... drilled, apply liberal

The three points covered in this excerpt from the United States Steel folder, "Fences That Pay," could prove very helpful to farmers planning a new fence. That's why United States Steel has made available this folder and two others—"Fence Planning Saves" and "A Boring Tale." You can make sure the farmers and ranchers you serve have this valuable information by getting a supply of these folders and passing them out to interested persons. Just use the convenient coupon to order your folders.

Figure 10b.
Stretching Fen
A contour fenc
only one-half to
as a straight lin
the curve, the
applied. When
go along it sev
it wherever it
the posts.
On sharp curv



Another way you can help farmers and ranchers have better fences is to keep them informed about pressure-creosoted fence posts. Advise them that posts properly pressure-treated with creosote have a much longer life span than untreated posts, and in the long run have a much lower annual unit cost. The slight additional cost for pressure-treatment is more than offset by their long service and freedom from repairs and maintenance.

UNITED STATES STEEL · USS CREOSOTE

UNITED STATES STEEL

Agricultural Extension
United States Steel Corporation
525 William Penn Place, Pittsburgh 30, Pa.

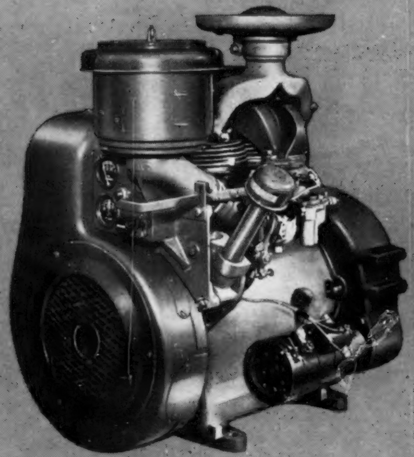
Please send me a free supply of the United States Steel folders on pressure-creosoted wood.

Name...

Address...

City............................State..........

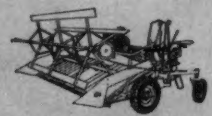
ONE ENGINE . . . with a knack for all trades!



REFRIGERATION
by Tru Kooler

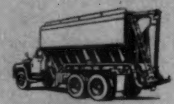
IRRIGATION
Pump by Warren Mfg. Co.

DRILLING
Drill Rig by Carey Mach. and Supply, Inc.



AGRICULTURE
Windrower by Owatonna Mfg. Corp. and Hesston Mfg. Co.

CONSTRUCTION
Contractor's Hoist by Buck Equip. Co.



MATERIALS HANDLING
by Sprout-Waldron

The *FULL POWER* LYCOMING C2-90

Air-Cooled! Rated 30 h.p.—Delivers 30 h.p.!

Here's the tough, versatile engine that has an amazing variety of applications. And in this variety, the C2-90 is exposed to the most exacting working conditions . . . tested and proven in the field.

This amazing 30 h.p. unit offers you:

- The traditional air-cooled advantages of lighter weight, lower cost, all-weather performance, and superior endurance.
- FULL POWER performance—rated at 30 h.p.—*delivers* 30 h.p.!
- Highest horsepower and torque per cu. in. displacement in air-cooled field.
- Complete interchangeability—identical mounting and shaft dimensions with other major air-cooled industrial engine units in horsepower range.
- Reliability and simplicity for easy maintenance.

Yes! This engine does just what we say it will do. That's why it has been chosen by leading equipment manufacturers like those in the applications illustrated. Find out how Lycoming's 45 years of engine-building experience can solve your problems. Write:
Sales Engineering, Industrial Engines, Lycoming, Williamsport, Pa.

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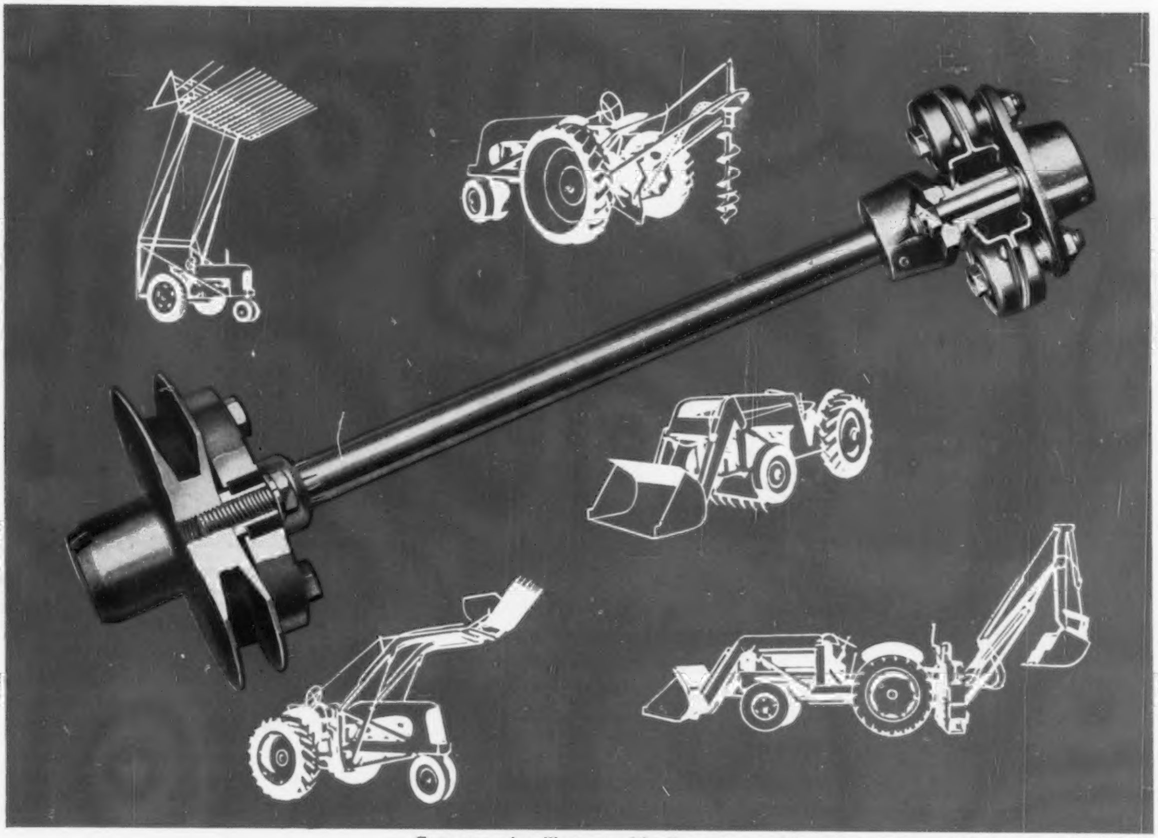
defense and industrial products

The secret behind the Morflex Driveshaft's amazing ability to . . .

end vibration and misalignment problems in PTO Pump Drives



Cut-away view illustrates Morflex neoprene biscuit principle applied at both ends of shaft.

Driveshaft vibration and misalignment of the pump frame support have always been twin bugaboos with tractor power-takeoff drives. They put excess strain on hydraulic pumps and quickly wear out pump bearings.

The Morflex Driveshaft solves this problem. Special resilient neoprene biscuits in the driveshaft couplings give unusual torsional flexibility; compensate for all conditions of shaft misalignment: angular, axial, and parallel. The special design of the neoprene biscuits absorbs vibration, provides uniform stress and deflection under all operating conditions.

Unaffected by dust, dirt, water or weather, Morflex Driveshafts are ideal for the roughest jobs. They require no lubrication or maintenance.

Compact Morflex Driveshafts fit limited space requirements; can be designed to fit specifications of mass-produced, tractor-mounted equipment.

If you have a PTO driveshaft problem, it will pay you to investigate Morflex Driveshafts. Phone, wire, or write us today for fast assistance and full details. MORSE CHAIN COMPANY, INDUSTRIAL SALES DIVISION, ITHACA, NEW YORK.

MORSE MORSE BW* **POWER TRANSMISSION PRODUCTS**

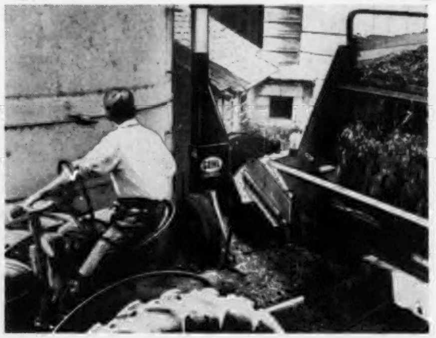
*Trademark

New dry sprayer for granular insecticide . . . Century Engineering Corporation

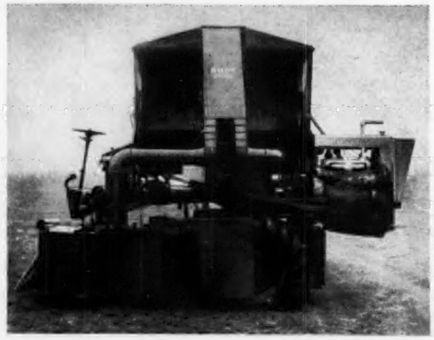
Latest type gas engine drive auger elevator Kooiker Manufacturing Company

The Implement Industry looks ahead—with

New all-purpose self-unloading side-delivery forage box . . . Gehl Bros. Manufacturing Company



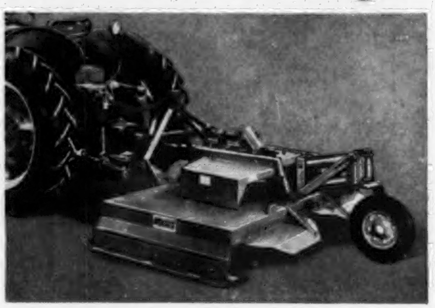
Latest model Rust cotton picker . . . Ben Pearson Incorporated



new, ever-better machines powered through

Schmidt one-man portable ditch pump . . . Blackwelder Manufacturing Company

New model rotary mower-shredder . . . Wood Brothers Manufacturing Company

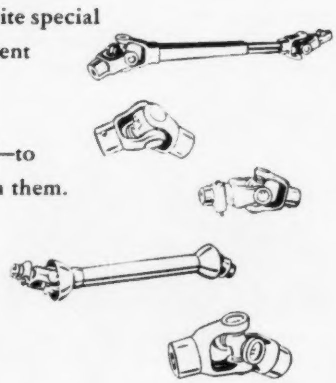


BLOOD BROTHERS Drive Line Assemblies

Some of these implements are new and unique—designed to expedite special or advanced farming methods. Others are improved, more efficient models that cut labor hours to new minimums.

Yet these are just a few examples of *many* ever-better machines offered by a dynamic Implement Industry that is *looking ahead*—to assure healthier profits for dealers and the farmers who buy from them.

Also significant: *All* these models include Blood Brothers Universal Joints and Drive Lines . . . the top-quality components that help *any* implement work better—*sell better!*



FOR FARM IMPLEMENTS, MORE BLOOD BROTHERS UNIVERSAL JOINTS ARE USED THAN ALL OTHER MAKES COMBINED.

TAKES POWER AROUND CORNERS

BLOOD BROTHERS MACHINE DIVISION

ROCKWELL SPRING AND AXLE COMPANY

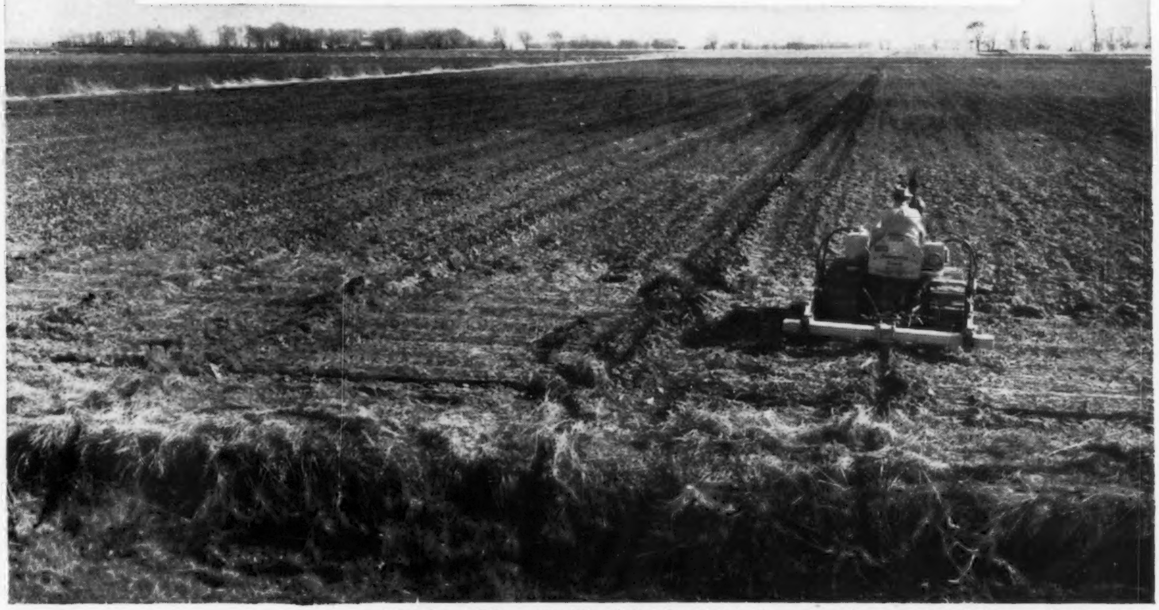
ALLEGAN, MICHIGAN

UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES

BIG CHANGE on V. R. Fate's farm since he bought his D2!

HERE ARE SOME JOBS HE DOES:

- ✓ levels land
- ✓ subsoils to break hardpan
- ✓ builds and straightens ditches
- ✓ repairs roads
- ✓ clears fence rows
- ✓ drains potholes



Vern Fate's D2 and Tool Bar Subsoiler Moleball run an underground drain from pothole to ditch.

These are a few examples of the big change on Vern Fate's farm near Claremont, Minn., since he bought his CAT* D2 Tractor. Here are Mr. Fate's own words: *"I do all the heavy farm jobs with the D2 with a good 50% savings in wages and fuel costs. I've found the D2 to be a mighty efficient farm tractor, and in addition, the Tool Bar with attachments makes the D2 an all-around-the-year piece of machinery!"*

Today's well-rounded farming program requires a tractor capable of handling your heavy-duty farm jobs with great efficiency—*and* much more! You'll make the D2 your No. 1 tractor for routine jobs. You'll discover new opportunities for profit and pleasure by improving your farm and boosting your income by doing custom work and extra jobs. You'll get a thrill out of owning and operating the D2, because here's power, maneuverability, usefulness and traction like you've never known in other tractors.

To get all the details on owning a D2, call your dealer. *Name the date, he will demonstrate!*

CATERPILLAR TRACTOR CO., Peoria, Illinois, U.S.A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

CONSERVE SOIL, WATER, MANPOWER AND MONEY WITH A CAT D2 TRACTOR

AGRICULTURAL ENGINEERING

VOL. 37 OCTOBER, 1956 No. 10

Low Section Height Tires

— Preferred as Oversize Tires for General Purpose Farm Tractors

AN ASAE Recommendation, recognizing low section height tractor tires as preferred for oversizing tires on farm tractor drive wheels, has been approved by the Technical Committee of the Power and Machinery Division of ASAE. The recommendation evolved from a cooperative effort made by engineers in the farm tractor and rubber tire industries to provide a means of meeting increasingly important field and operating requirements without resorting to the use of oversize tires, as used in the past, with resulting differences in rolling radii and outside diameters.

Following is a background of the development of low section height tires, as presented in a paper, entitled Farm Tractors and Their Tires, by F. C. Walters and W. H. Worthington*:

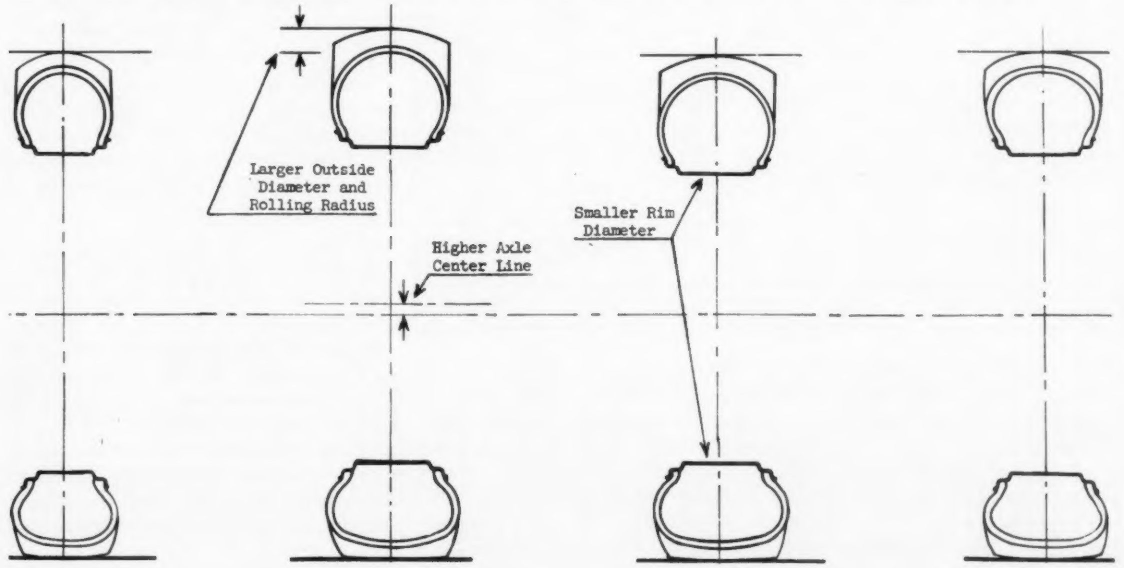
In the past, two methods of oversizing tractor tires have been used.

Introduction of an oversize tire having the same rolling radius, outside diameter, rim diameter and axle height as the basic tire permits basic and oversize tires to be used interchangeably without affecting the tractor travel speed, drawbar performance, center of gravity or geometric relationship to implements

Method A — Using oversize tires having the same bead seat diameter as the basic tire, but with section widths, outside diameters, and rolling radii all respectively larger than those of the basic tire. Fig. 1 (oversize Type A) shows that this practice results in a considerable increase in rolling radius accompanied by corresponding changes in the height of the rear axle, drawbar and integral implement attaching points, and alters the linkage geometry.

*The paper, "Farm Tractors and Their Tires" was presented at the national tractor meeting and production forum of the Society of Automotive Engineers at Milwaukee, Wis., September, 1955. Reproduced by permission of the SAE.

Fig. 1 — COMPARISON OF CHARACTERISTICS BY TYPES OF OVERSIZE TIRES WITH THE BASIC TRACTOR TIRE



Basic Tire

Oversize Type A
Greater—section width
Larger—outside diameter, rolling radius
Higher—axle
Same—rim diameter

Oversize Type B
Greater—section width
Smaller—rim diameter
Same—axle height, rolling radius, outside diameter

Low Section Height Tire
Greater—section width
Same—rim diameter, rolling radius, outside diameter, axle height

ASAE RECOMMENDATION:

PREFERRED DRIVE WHEEL TIRE AND RIM SIZES FOR GENERAL PURPOSE FARM TRACTORS (28-INCH TO 38-INCH, INCLUSIVE)

This Recommendation was prepared through the joint efforts of the Advisory Engineering Committee of the Farm Equipment Institute, the Tractor Technical Committee of the Society of Automotive Engineers and engineers in the tire industry, to provide means of meeting increasingly important field and operating requirements without resorting to the use of "oversize" tires as in the past with resulting differences in rolling radii and outside diameters. Groups of drive wheel tires are established herewith with each group of one or more tire sections characterized by having a substantially common rolling radius and outside diameter. Rim widths have been evidenced with respect to tire sections, so as to provide greater ground contact, better flotation and reduce soil compaction.

Only Regular Agricultural Tires (Classification R-1)* with diagonal lugs are included in this Recommendation. Cane and Rice Tires (Classification R-2)* and Industrial Tires (Classification R-3)* are omitted, due to their limited use. The advantages resulting from the use of these preferred tires have been found to be as follows:

1 Number of sizes is reduced.

2 The mounting points for all rims specified for each group are identical, permitting their interchangeable use on a common wheel.

3 Relationship of tractor, implements and ground not significantly disturbed when oversize tires are used.

4 In groups I and II, which include tires for use on the larger general purpose tractors, the outside diameters of the largest oversize tires are smaller than heretofore. This is favorable to a low center of gravity and permits mounting implements closer to the rear axle than has been possible when it was necessary to allow greater space for the use of oversize tires. In turn, this reduces the mass of the auxiliary front end weight necessary to balance rear mounted implements and makes for improved longitudinal stability and greater safety.

5 Travel speeds and drawbar pull are not significantly affected by the use of oversize tires.

*Classifications conform with Standards WT-2C, AT-2C and ATI-3A established by the Tire and Rim Association (1956).

GROUPS OF PREFERRED DRIVE WHEEL TIRE AND RIM SIZES FOR GENERAL PURPOSE FARM TRACTOR

Tire Designation	Loaded Radius-Inches	Section Width Inches	O D Inches	Bead Seat Dia Inches	Rim Width Inches
Group I					
15.5–38	28.5	15.5	61.6	38.188	14
13.6–38	28.5	13.6	61.6	38.188	12
12.4–38	27.8	12.4	59.8	38.188	11
Group II					
13.9–36	26.8	13.9	57.8	36.188	12
12.4–36	26.8	12.4	57.8	36.188	11
11.2–36	26.0	11.2	55.3	36.188	10
Group III					
11.2–34	25.0	11.2	53.3	34.188	10
Group IV					
13.6–28	23.5	13.6	51.6	28.188	12
14.9–28	24.5	14.9	54.0	28.188	13
Group V					
12.4–28	22.8	12.4	49.9	28.188	11

NOTE: The tire section dimensions shown are obtained with the rim widths as specified. All dimensions subject to standard tolerances of tire and rim manufacturers.

Method B — Using oversize tires having increased section widths with respect to the basic tire, but with approximately the same outside diameter and rolling radius. Fig. 1 (oversize Type B) shows that this method provides an increase in section width without disturbing the height of the rear axle, drawbar, implement attaching points or linkage. It has the serious disadvantage of involving different rim diameters and mounting methods.

Providing oversize tires using method A as shown in Fig. 1 (oversize Type A) has resulted in such difficulties as: tire side wall buckling; side-wise rolling when operating on a slant hillside or with one wheel in a deep furrow; increased travel speed without corresponding increase in engine and power take-off shaft speed; reduction in drawbar pull; decrease in tractor stability both laterally and longitudinally; and less satisfactory integral implement performance.

From the viewpoint of tractor and implement performance, use of method B, (oversize Type B, Fig. 1) which provides the desired increase in section width without departing from the outside diameter and rolling radius of the basic tire, becomes very attractive. The principal advantages afforded by method B as compared with method A may be summarized to include:

- Basic and oversize tires can be used interchangeably without significantly affecting travel speed and drawbar performance.
- Distance of center of gravity of rear mounted implements from rear axle may be determined by the outside diameter of the basic tire rather than that of the largest oversize tire. This improves the longitudinal stability of the tractor-implement combination, improves maneuverability, lessens the demand on the hydraulic system, and reduces the auxiliary front end weight necessary to provide adequate stability under adverse field conditions.
- The use of oversize tires does not disturb the geometric relationship of the tractor, the ground and rear or front mounted integral implements.
- Use of an oversize tire does not change the vertical location of the tractor's center of gravity. As a result, the safety of the tractor against backward and sideways upsets is measurably improved.

However, the choice of oversizing method must be qualified by considerations of tire performance. Tests conducted in Arizona by the John Deere Waterloo Tractor Works subsequently verified at the USDA Tillage Laboratory at Auburn, Ala.† indicated that where all tires of a series were loaded to approximately the same basic weight, method A oversizing practice resulted in slightly better traction performance than did method B. Again, other tests made in Arizona under similar conditions showed contradictory results with no advantage in performance resulting from the increase in outside diameter and rolling radius.

Because of the advantages afforded by method B, other ways of attaining these benefits were investigated in the

†Results of these tests have been reported in an article, "Some Effects of Oversizing Rear Tractor Tires," by I. F. Reed, in AGRICULTURAL ENGINEERING for September, 1955.

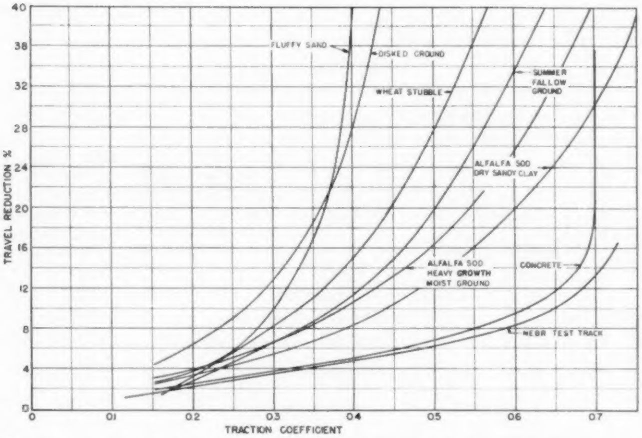


Fig. 2 Summary of data obtained from a series of tests to determine the effect of traction coefficient on travel reduction under various soil and surface conditions

hope that some of the disadvantages of the practice might be avoided.

As a result a third method was evolved:

Method C – Providing oversize tires having section widths greater than that of the basic tire, but maintaining the same rim diameter and approximately the same outside diameter and rolling radius. Therefore, the ratio of section height to width is smaller on the oversize tires. These tires are called "low section height" tires and are shown in Fig. 1.

A close review of methods B and C shows the following:

- Both methods provide a range of section widths, all with approximately the same rolling radius. However, method C utilizes the same drive wheel hub and rim well diameter with all section widths. This is accomplished by varying the ratio of the section height to width as the tire width increases.
- Method B requires different drive wheel hubs and rim diameters with increasing tire section widths; however it does maintain the same ratio of tire section height to width.

To evaluate the relative traction performance afforded by tires corresponding to methods B and C, co-operative field test programs were undertaken at Colby, Kansas and Columbiana, Ohio.

Table I lists the groupings, sizes and weight capacities of the tires used in these tests.

TABLE I–TIRE DIMENSIONS AT 12 LB. PRESSURE

Test group	Tire size	Ply rating	Rim width, in	Section width, in	Outside diameter, in
I & II	12-38	6	11	13.2	61.5
	38-13	6	12	13.9	61.84
	38-14	6	14	15.47	61.81
	13-36	6	12	14.4	62.0
	14-34	6	13	16.0	62.2
III & IV	14-34	6	14	16.23	62.28
	34-15	8	16	18.22	62.49
	34-18	8	18	20.55	62.87
	15-30	6	14	17.87	61.38
	18-26	8	20	23.17	62.51
V & VI	11-28	4	10	11.9	49.8
	28-12	4	11	13.1	49.8
	28-13	4	12	14.4	49.8
	12-26	4	11	13.1	49.6
	13-24	4	12	14.4	50.0

Tractive surfaces for the work in the field varied from light loam soil with wheat stubble and summer fallow surface to moist clay loam with an alfalfa sod.

To eliminate the variable represented by the weight carrying capacity of these tires, the comparative evaluation of tire performance is based on traction coefficient, travel reduction, and tire efficiency.

To provide a basis for comparison with much background information currently available, an additional evaluation was made on the basis of tire horsepower and tire net force output.

In conducting all tests involving any specific tire grouping, the individual tires were all operated at the same rolling radius circumferential velocity. This was done to eliminate any effect that variation in rolling radius might have on tire horsepower. In this way, variations in tire horsepower output would result directly from the difference in section width and not from travel speed. Additionally, all tests were so conducted that at times sufficient engine power existed to produce "traction stalls" rather than "power stalls." This was

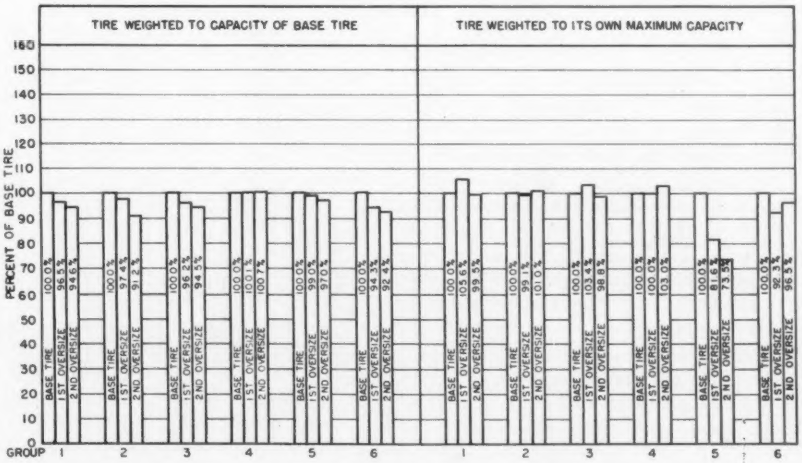


Fig. 3 No significant difference was found in traction coefficient when each tire was loaded to its individual capacity as shown in right portion of chart. Performance of the basic tire was slightly better when all tires were loaded to the capacity of the basic tire (left portion of chart). Traction coefficient is expressed in terms of the basic tire at 16 percent travel reduction

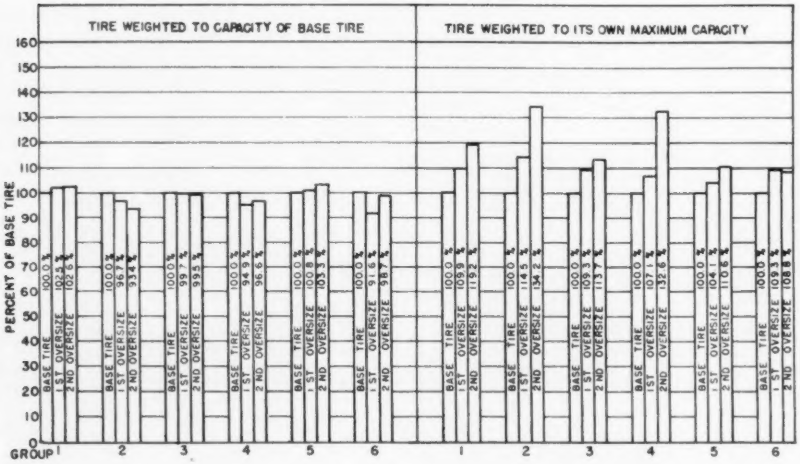


Fig. 4 Net force output increases directly according to tire loading as shown in right portion of chart. No increase results when oversize tire is weighted to capacity of basic tire (left). Net force output is expressed in terms of the basic tire at 45 percent travel reduction

done to insure that resulting data reflect only the tire performance and are not affected by the available engine power.

In the tests that were conducted with all tires loaded to approximately the rated capacity of the basic tire at 12 psi inflation, a comparison of the values of traction coefficient and travel reduction (slippage) shows that many of the curve traces intertwine, evidencing close conformity and lack of divergence in the performance characteristics afforded by the various types and sizes of tires. Where each tire was loaded to its rated capacity at 12 psi inflation pressure, these figures again show close conformity and intertwining of the various curve traces. Where any one tire evidenced a slight improvement in performance under a given soil condition, a tire with different width of section afforded better performance under some other soil condition.

As would be expected of tests involving different types of soil and surface conditions, varying values of traction coefficient were found. The curves in Fig. 2 represent a summary of all data secured throughout the entire series of tests. An interesting facet of this study is the close conformity of tractive performance applying to each soil and surface condition, without respect to tire section width.

Observations of actual farming operations where the tractors were driven by their owners, together with much other field test data, indicate that approximately in the order of 15 to 16 percent travel reduction is common, and is apparently acceptable to the users. Results of other tests indicate that where high tire slippage results in a tendency to "dig in," maximum traction output occurs at approximately 45 to 50 percent travel reduction. Using this as a basis for further analyzing performance data secured during these tests, the charts shown in Fig. 3 were prepared.

Fig. 3 shows the effect of section width on traction coefficient. The left portion of the graph shows values of traction coefficient occurring where the oversize tire was carrying the same load as the basic tire. The right portion shows values of traction coefficient where each tire was loaded to its rated capacity at 12 psi inflation pressure. From these operations under closely controlled soil and surface conditions, the following conclusions are evident:

(a) When the basic and oversize tires were loaded to the rated capacity of the basic tire, the performance of the basic tire was slightly better than the oversize tires.

(b) When each tire was loaded to its individual rated capacity, no significant difference was found among the values of traction coefficient of any of the tires tested.

(c) When flotation is adequate, the traction advantages

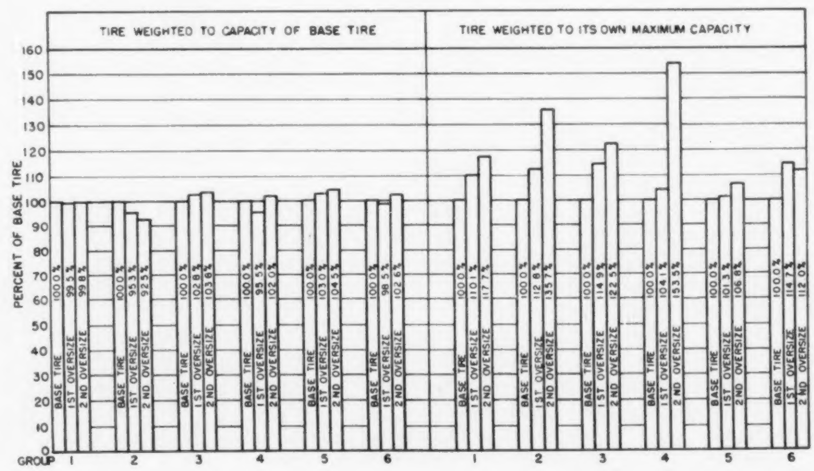


Fig. 5 The effects of the use of oversize tires become apparent when tire horsepower is considered. When oversize tires are weighted to the capacity of the basic tire the difference in tire horsepower is slight. Tire horsepower is expressed in terms of the basic tire at 16 percent travel reduction

resulting from the use of oversize tires are directly proportional to their loading. In other words, unless the greater load carrying capacity of the larger sections is utilized by adding ballast — either liquid or cast iron — beyond the load capacity of the basic tire, no traction advantage results. On the contrary, oversize tires may not have the traction afforded by the basic tire under the same condition.

Fig. 4 shows characteristic tire performance as net force output at 45 percent travel reduction. A study of these data reveals:

(a) Considering all tires of any group tested with the oversize tires loaded only to the capacity of the basic tire, little difference in net force output was observed.

(b) When any oversize tire was loaded to its full rated capacity, the net force output was greater than that of the basic tire, and directly according to the tire loading.

Referring to Fig. 5, the effects of the use of oversize tires on tire horsepower become apparent. In general, the same trends exist as those characterized by a comparison of net force output. Where any difference in performance was found, it was magnified by the change in travel reduction (slippage) characteristics. The benefits gained from increased tire loading are evident. Here again, no significant improvement in performance is gained through the use of oversize tires, unless advantage is taken of their greater weight carrying capacity.

Summarizing Figs. 3, 4 and 5, the following becomes evident:

(a) Section width has little effect on traction coefficient. What effect did exist favored the smaller section width tire.

(b) Unless advantage is taken of the greater weight carrying capacity of oversize tires, little to no advantage is gained through their use.

Where each tire was operating under its capacity load, the effects of the added weight are clearly evident in both its tire horsepower and net force output. Fig. 6 shows a comparison of basic and oversize tire performance in terms of gain in tire horsepower and net force output plotted against increase in tire loading. Basic tire power and weight are taken as 100 percent in both cases.

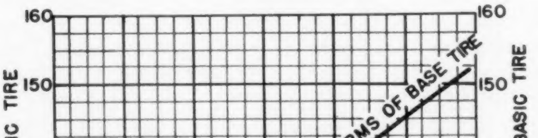


Fig. 6 Comparison of basic and oversize tire performance in terms of gain in tire horsepower and net force output as tire loading is increased. Basic tire power and weight are taken as 100 percent

Tire sections with load carrying capacity up to approximately 130 percent of the base tire may be loaded to develop a corresponding increase in tire horsepower, as compared with the basic tire. When loaded in excess of this amount, the rate of increase in tire horsepower is no longer proportional to the increased load.

Tire sections which allow up to 130 percent increase in load carrying capacity of the base tire have approximately a 120 percent increase in net force output in terms of the base tire.

This analysis of the field performance of basic and oversize tires with common tread designs, outside diameters and rolling radii operating under a wide variety of carefully controlled soil and surface conditions leads to the following conclusions:

- The ability of an oversize drive wheel tire to increase tractor performance is largely a function of any additional weight that can be carried safely by the tire and not the result of section size or configuration (as distinguished from type of tread).
- Where the weights carried by the various tires are nearly equal, there is no significant difference in the performance characteristics of comparable low section height (method C) and conventional design oversize tires (method B).
- The traction coefficients and tire efficiencies of the narrowest or basic tire are generally equal to, or slightly better than, those of the corresponding oversize tires. This was found to be true for any soil conditions tested, regardless of rear axle weight.
- Because performance is directly dependent upon the weight carried by the tire, oversize tires with conventional section configuration have a performance (tractive effort) potential slightly greater than tires of low section height configuration. This is because the volume available for carrying liquid ballast and the rated load capacity of the former are both greater than that of the latter.
- It has been demonstrated that the many advantages resulting from the use of basic and oversize tires with common outside diameters and section heights (method C) may be secured without sacrificing tractive performance, as compared with oversize tires of conventional section configuration (method B).

Correction

THE attention of readers is called to two corrections in the article, entitled "Soil Penetrometer Employs Strain Gages," by R. J. Hanks and K. A. Harkness, on pages 553 and 554 of AGRICULTURAL ENGINEERING for August, 1956, as follows:

The formula in the footnote at the bottom of the second column on page 553, as corrected, reads as follows:

$$S = 6\ FL/MT^2W.$$

The first footnote at the bottom of the first column on page 554 was incomplete and, as corrected, reads as follows:

"For simulated strain equivalent to one-half total range of strain measured (for the circuit of Fig. 4) the value of R_c is : $R_c = R_g\ [(1/2S_mG) - 1]$, where R_g is the strain gage resistance, S_m is the maximum strain to be measured and G is the gage factor of the strain gages."

Hood Inlet for Closed Conduit Spillways

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THE hood inlet for closed conduit spillways and culverts is formed by cutting a pipe at an angle. The long side is placed on top and figuratively forms a hood over the entrance. An anti-vortex wall located along the pipe centerline completes the inlet.

The astounding thing about this very simple inlet is its superior hydraulic performance. The hood inlet will cause the conduit to flow completely full, no matter what the slope of the conduit may be, if the length of the hood is properly selected. This filling of the conduit is completely reliable and predictable. Furthermore, the submergence of the inlet to insure full flow is a desirable, low figure.

Background

Closed conduit spillways are used in large numbers by the Soil Conservation Service in connection with their district, agricultural conservation, group enterprise, flood prevention, and watershed protection programs. The number of small farm or stockwater ponds and larger flood detention reservoirs constructed annually number over 100 thousand. Many of these have closed conduit spillways, although figures giving the exact number are not available. It is thus apparent that the closed conduit spillway is an important structure. Furthermore, highway culverts, a form of the closed conduit spillway, are installed in large numbers every year.

The closed conduit spillway has been used by the Soil Conservation Service since 1933. The design of the initial structures was reported by L. H. Kessler (1)*. The results of unpublished tests (2) conducted in the 1940's provide the criteria for the design of drop inlet spillways using pipe conduits. These drop inlets had to be relatively high to insure satisfactory performance. Continual objection to the use of these high drop inlets has been voiced since the specifications for their design were introduced. Studies in 1951 (3) showed that the height of the drop inlet could be reduced greatly if the entrance at the bottom of the drop inlet was properly shaped. Nevertheless, the use of the drop inlet usually requires setting forms and pouring concrete in the field.

In the spring of 1955, Karr and Clayton (4) reported the discovery of an inlet having no drop inlet at all, yet having the desirable characteristics of insuring full conduit flow at steep conduit slopes. Study of this report prompted the Soil Conservation Service to request that the Agricultural Research Service conduct additional tests at the St. Anthony Falls Hydraulic Laboratory.

After the present studies had begun, results of studies on

Surprising hydraulic characteristics are displayed by a hood inlet for closed conduit and highway culverts, formed of simple construction by cutting a pipe at an angle and attaching an anti-vortex wall

a similar entrance, discovered by L. Donald Meyer at the University of Missouri, were published by Beasley and Meyer (5). However, by that time the present studies were so far advanced that the Missouri results did not influence the program.

The inlet has been named the hood inlet because of the projection of the crown of the pipe upstream of the invert. This inlet form showed excellent hydraulic characteristics from the very first test. Because of the potential value of this inlet it was given top priority. As a result it was subjected to more detailed study than any other closed conduit spillway entrance now in use and less than a year it was developed to the point where it can be recommended for field use.

Hood Length

The top of the pipe should project beyond the invert by ¾-pipe diameter for the best angle of the hood. For a 12-in pipe the crown projects 9 in beyond the invert; for a 24-in pipe the crown projects 18 in beyond the invert, etc.

An extensive series of tests was performed to determine the optimum hood length. Hood lengths of 0-, ⅛-, ¼-, ⅜-, ½-, ⅝-, ¾- and 1-pipe diameter were tested. The best hood length was determined for barrel slopes of 0, 2.5, 5, 10, 20, and 36 percent. The wall thickness was about 0.03 in. This was as thin as could be machined from Lucite without difficulty. All inlets were re-entrant. Thin-walled, re-entrant inlets were used because it was thought to be the most severe test of inlet performance.

The minimum head over the invert at the inlet at which the inlet "primed" and the pipe tried to flow full was obtained when the hood length was ¾-pipe diameter. This statement applies for pipe slopes from 2.5 to 36 percent; the zero slope was so flat that pipe friction, rather than the inlet, governed the filling. The 1-pipe diameter hood length (pipe cut on a 45-deg angle) had equally good, but no better, hydraulic performance than the ¾-pipe diameter hood length.

The priming head for the shorter hood lengths was always greater than for the ¾- and 1-pipe diameter hood lengths. The priming head increased sharply as the hood length decreased until, for the ⅛-pipe diameter hood length and 0-pipe diameter hood length (pipe cut at right angles), the relatively deep laboratory test channel almost overflowed, yet the inlet did not prime.

The mechanism by which the inlet primes explains why a closed conduit spillway with a hood inlet fills at such low headpool levels. The hood inlet may be likened to an orifice directed upward at an angle. When the hood inlet is flat enough with respect to the conduit axis, the jet issuing from the entrance orifice impinges on the crown of the pipe

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Roanoke, Va., June, 1956, on a program arranged by the Soil and Water Division. The studies were conducted at the St. Anthony Falls Hydraulic Laboratory by the watershed hydrology section, (SWCRB, ARS) U. S. Department of Agriculture, in cooperation with the Minnesota Agricultural Experiment Station and the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota.

The authors—FRED W. BLAISDELL and CHARLES A. DONNELLY—are hydraulic engineers, watershed hydrology section (SWCRB, ARS) U.S. Department of Agriculture.

*Numbers in parentheses refer to the appended references.

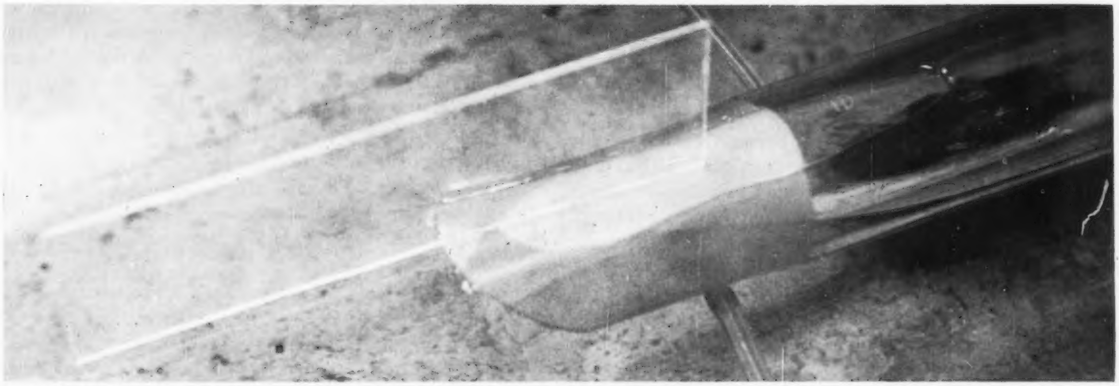

Fig. 1 Hood inlet is shown at instant of priming. The headpool level is below the pipe crown and the water inside the hood inlet rises above headpool level. A pressure connection leads from the invert

and seals it off. This sealing off, shown in Fig. 1, occurs just inside the tip of the hood. The recommended hood inlet length causes the water level inside the entrance to rise above the level of the headpool, thus priming occurs before the inlet is submerged. For short hood lengths, the jet falls downward and the level inside the entrance is lower than the headpool level so that priming does not occur until after the inlet is completely submerged. The phenomena of priming is so marked that the best length of hood could have been closely estimated on the basis of visual observations.

As the discharge increases after the inlet primes, the barrel fills for a short distance. This creates additional head and sucks water away from the inlet. If the demand thus created for water is greater than the supply, the difference is made up by sucking air. Air is sucked in and carried through the conduit from the time the inlet first primes until the water flow to the spillway is sufficient to satisfy the demand for water. The headpool level raises slowly during the period when air enters the spillway until the conduit flows full of water. The essential maximum capacity of the spillway is thus achieved with small increases in headpool level and low depths of flow at the entrance. This phenomenon is characteristic of siphon spillways but has never before been observed in such a simple structure.

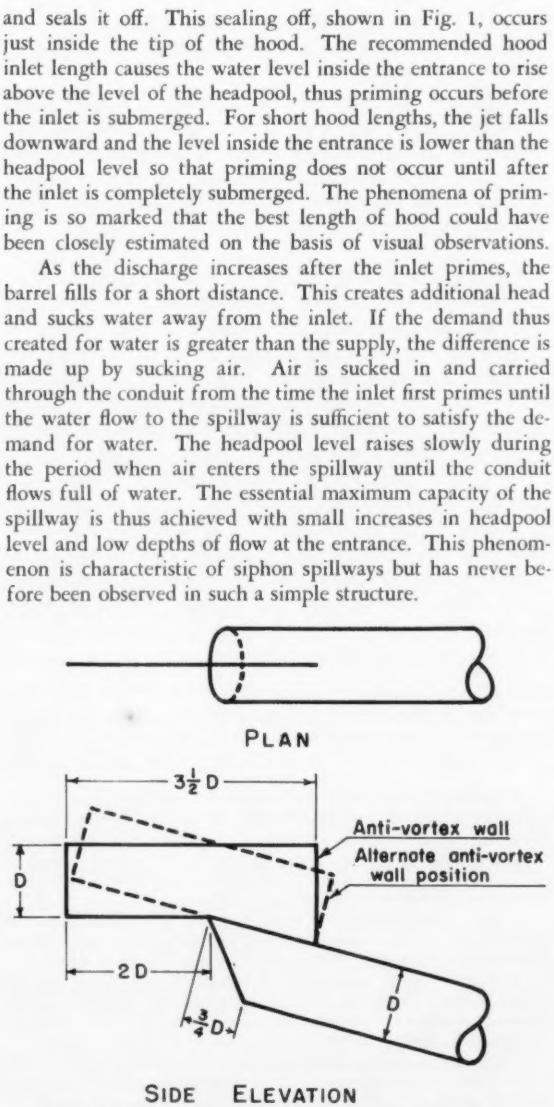

Fig. 2 Dimensions of the hood inlet and its anti-vortex wall

Entrance Loss

The entrance loss currently suggested for the hood inlet with a length of ¾-pipe diameter is 1.0 times the velocity head in the conduit. Lower values ultimately will be recommended for special entrance conditions, but there is not space here to outline the conditions that must be met.

Anti-Vortex Wall

The use of some type of device to inhibit vortex formation is absolutely necessary. Only one-third as much water entered the spillway during a test in which an anti-vortex wall was omitted compared to the same spillway with the anti-vortex wall in place. The discharge also is completely unpredictable when the anti-vortex wall is omitted. A large vortex may admit large quantities of air that replaces the water at one moment, while at a later moment the vortex may disappear and the conduit flow at its full capacity. A predictable, head-discharge relationship is possible only if the vortex formation is inhibited. The anti-vortex wall performs this function. An anti-vortex wall is not needed until the inlet becomes submerged, nor is it needed for extremely high submergences. Its greatest need is at low submergences of the inlet.

The anti-vortex wall dimensioned in Fig. 2 is recommended. It is the smallest wall that adequately inhibited vortices. Vortices form around the ends of the wall if either end is shortened. Greater wall heights resulted in only slight improvements in performance. Small transient vortices sometimes formed even with this anti-vortex wall. However, they were mostly on the surface and the occasional vortex that admitted air to the spillway did so only momentarily and the quantity of air admitted was small.

The recommended anti-vortex wall is a thin wall located on the centerline of the conduit. It is 3.5-pipe diameters in length by 1-pipe diameter in height with 2-pipe diameters of the length projecting beyond the hood tip and 1.5-pipe diameters of the length attached to the outside crown of the pipe.

Pipe Wall Thickness

Tests were made to determine the effect of the thickness of the pipe wall on the performance of the hood inlet. The edges were square in all cases to simulate a pipe cut at an angle with a saw.

Regarding priming action, the thickness of the pipe had no apparent effect. The thick-walled pipes primed equally

as well as the thin-walled pipes. This was expected. Also expected was the lower entrance loss. However, it is suggested that the entrance loss previously given be used until the results of the tests can be presented in detail.

Conduit Slope

No effect of conduit slope on the performance of the hood inlet was apparent if the conduit slope was steeper than the friction slope. As noted previously, the same optimum hood length was obtained for all conduit slopes.

One surprising effect of slope was noted. When the conduit slope is less than the friction slope, the conduit should fill for all entrance conditions if the conduit is "long" as defined by Straub, Anderson and Bowers (6). However, the contraction at the entrance of a pipe cut at right angles to the centerline is so great that many culverts must be classified as "short", even though the culvert slope may be considerably less than the friction slope. Such a condition does not exist for the hood inlet and all closed conduit spillways or culverts having a properly proportioned hood inlet fall into the "long" category.

It had been anticipated that the hood inlet would be particularly desirable for conduits located on steep slopes. It now appears that the hood inlet may also have unanticipated desirability for conduits located on flat slopes.

Approach Conditions

The hood inlet projected into the headpool for most of the tests. However, a few tests were made with the inlet invert located on the face of a dam sloping 1 on 3.37. A berm level with the inlet invert was also used. A scour hole was allowed to develop for some tests, while for other tests the dam face and berm were paved to prevent scour.

No detrimental effect of any of these approach conditions on the priming characteristics or the general performance of the spillway were noticeable. The paved surfaces served to reduce the entrance loss somewhat. The entrance loss when the scour hole was allowed to develop was intermediate between that obtained with the berm and that obtained with the re-entrant entrance.

Scour at Inlet

The velocities close to the hood inlet entrance are high. As a result, scour can be expected if the dam face is not protected. Studies have been conducted which show the relationship between the pipe diameter, the discharge, and the size of bed material as they affect the depth and diameter of the scour hole. Four different discharge rates and seven different sizes of bed material were tested. Surprisingly, the data showed good correlation and the results were reduced to the form of dimensionless equations.

The equation giving the size of bed material that is just ready to be picked up is

$$d/D = Q/20D^{5/2} - 0.075 \qquad [1]$$

where d is the grain diameter in feet for imminent movement, D is the pipe diameter in feet and Q is the discharge in cubic feet per second. This equation is valid only for grains 3 mm and greater in diameter.

The equation giving the depth of the scour hole below the inlet invert y is

$$y/D = Q/20D^{5/2} - d/D - 0.075 \qquad [2]$$

The radius of the scour hole r from the hood inlet invert is

$$\frac{r}{D} = \left(0.15 + 0.04\frac{Q}{D^{5/2}}\right)\left(\frac{D}{d}\right)^{1/5} \qquad [3]$$

These are observed quantities and no safety factor has been applied. In practice, the area to be protected against scour should be considerably greater than that given by equation [3]. It should also be recognized that uplift forces near the inlet are high. The paving should be sufficiently heavy to resist these forces and should be reinforced.

Equation [2] can be used to give the height of the inlet invert above an erodible surface if no scour is to take place. This equation gives the minimum height, and the height of the inlet should be considerably increased to provide a safety factor.

Equation [1] can be used to predict the size of riprap required. The equation gives the riprap size for imminent movement. Sizes should be at least doubled to insure no movement. The size of riprap required to prevent movement is large. During the tests a stone almost as large as the pipe was picked up when it was slightly disturbed and was carried through the pipe. The inlet was smashed in the process. In view of the size of riprap required, it is suggested that paving be used to prevent scour or that the scour hole be allowed to develop.

Although the velocities close to the inlet are tremendous, they decrease rapidly with distance away from the inlet. Therefore, the hole scoured in small-sized material is moderate in its dimensions and ordinarily will not endanger a structure if the presence of the scour hole is recognized and provided for in the design.

Summary

The hood inlet for closed conduit spillways is a simple and cheap structure that has excellent hydraulic characteristics. Vortices have a considerable effect on the inlet performance, but they can be controlled by a simple anti-vortex wall. The slope of the conduit has no apparent effect on the spillway performance. The approach conditions and the pipe-wall thickness also have no detrimental effect on the performance. Scour may occur at the entrance, but the scour hole has moderate depth and extent, and all scour can be prevented by paving the approach or by setting the invert above the erodible material. It appears that the hood inlet will be useful in connection with farm pond spillways, grade stabilization or gully control dams, irrigation drops, upstream floodwater detention structures, surface drainage drop structures, and highway culverts.

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Evaluating Tractor Seating Comfort

Harlan W. Van Gerpen
Member ASAE

Field testing apparatus measures operator seating comfort by recording vibration in the frequency range designated as jerk.

WHENEVER a new machine is invented, nearly all the initial engineering effort is directed toward developing the machine to the point where it will do the job for which it is intended. After this has been established to a satisfactory degree, efforts are then extended toward improving secondary features so as to offer the most attractive product possible to the customer.

One of these so-called secondary features which has become important in recent years is "operator comfort," one of the requirements for which is provision of a comfortable seat. Just what constitutes a comfortable seat or ride has long been a point for argument. As a result of the inability to judge objectively what is "seating comfort," a great deal of investigative work has been done. The goal in all of this research has been to establish or select a variable which would serve as a criterion for the measure of seating comfort.

Various investigators, notably Janeway, Jacklin, Goldman, Liddell, and Zeller, all working independently, arrived at very similar conclusions, which are summarized in the paper, entitled "Human Tolerance to Vibrations in Farm Machines," by Max Haack (AGRICULTURAL ENGINEERING, April, 1956).

It is generally agreed by these investigators that the criterion for measuring seating comfort depends upon the frequency range of vibration in the following manner:

Frequency Range	Criterion for Measuring Seating Comfort
1-6 cycles per second .	Jerk (time rate of change of acceleration)
6-20 cycles per second .	Acceleration
20-100 cycles per second	Velocity

An American agricultural tractor with rubber-tire drive wheels has a rear end natural frequency of vibration of approximately 3 cps (cycles per second). This will vary between 2½ to 3½ cps as tire pressure and tractor ballast are altered. With the predominant frequency in the 1 to 6 cps range, "jerk" may be considered the criterion for seating comfort on farm tractors.

Measurement of Jerk

The purpose of this paper is to describe a technique of instrumentation as developed and used by the John Deere Waterloo Tractor Works for evaluating seating comfort, specifically, the measurement of jerk.

The principal problem in the measurement of jerk is separating the desired signal from other stray high-frequency vibrations. This problem is particularly acute with the measurement of jerk as may be seen from the following relations:

If displacement $= x = A \sin \omega t$,

$$\text{then jerk} = \frac{d^3x}{dt^3} = j = -A\omega^3 \cos \omega t$$

where $\omega = 2\pi \times$ frequency

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Roanoke, Va., June, 1956, on a program arranged by the Power and Machinery Division.

The author — Harlan W. Van Gerpen — is research engineer, John Deere Waterloo Tractor Works.

Thus jerk amplitude varies as the third power of the frequency of the vibration. Actual physical values give this filtering problem more significance. For example, a 10-cycle vibration of 0.001-in displacement has the same maximum amplitude ($A\omega^3$) of jerk as a one-cycle vibration of 1-in displacement. It is important that any stray high-frequency vibrations, such as encountered in a tractor frame, be kept out of the result. This can be done effectively by means of electrical filtering.

As is frequently the case in instrumentation problems such as this, the equipment available directs the approach to the problem. Good accelerometer transducers are commercially available. Jerk transducers which were tried require excessive amplification and introduce more stray signal into the measurement. The calibration of jerk transducers requires a high-quality vibration table.

For this work a six-channel Brush oscillograph was available. Reference to amplifiers in this paper refer to the BL 320 and BL 932 amplifiers ordinarily used with the oscillograph. The same type of modification could be applied to other commercial recorders of a similar type. Statham accelerometers and General Electric integrators were used.

The instrumentation to measure jerk was set up in two distinct steps:

- Acceleration was recorded by means of an accelerometer transducer and continuous direct-recording oscillograph.
- The voltage across the final element of the acceleration recorder (pen motor) was "sampled", differentiated electrically and recorded on an adjacent channel of the oscillograph as jerk.

This procedure of using accelerometers has merit in that it permitted developing the instrumentation in steps. The first step was to develop a "flat response" measurement of acceleration from one cycle per second up to 6 to 8 cycles per second, but then cut the amplifier off very sharply at higher frequencies. The amplifier was modified with inserted capacitors so as to reduce the high-frequency response.

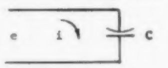
Field test in progress

The capacitor locations and values used are shown in Fig. 1. The dotted lines indicate the connections added to the original circuit. The dotted lines indicate the connections added to the original circuit. The values indicated give a "flat" response to 7 cps and then attenuate rapidly for higher frequencies.

The actual filtering capacitors are mounted outside the amplifier. The connection points in the circuit are brought to a microphone connector plug so that the filter circuit may be added or removed readily.

At these low frequencies the voltage across the terminals of the oscillograph pen motor is proportional to pen displacement on the chart. Therefore, a voltage proportional to acceleration is available. A differentiating circuit consisting of a capacitor and resistor was connected across these terminals. The voltage across the resistor was then amplified with a high gain d-c amplifier and recorded on the adjacent channel.

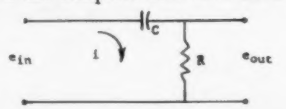
Consider the following electrical circuit relative to operation of an electrical differentiating circuit:



$$i=C\frac{de}{dt}$$

in which e=instantanteous voltage and i=instantaneous current. This relation shows that the current in a capacitor is proportional to the derivative of the applied voltage. In order to "sample" or record this current, it is necessary to insert a small resistance in the circuit so that a voltage may be obtained which is proportional to and in phase with the current. If the impedance (X_C) of the capacitor is ten to twenty times as large as that of the resistance, the capacitor will govern the current in the circuit and the above equation will be very little in error.

Following is the complete derivative circuit:



$$\text{if } x_c \gg R \qquad i \approx C\frac{de_{in}}{dt}$$

$$e_{out}=iR\approx RC\frac{de_{in}}{dt}$$

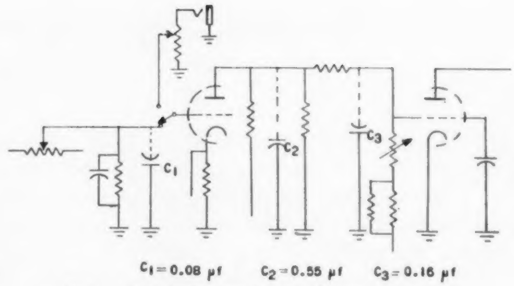
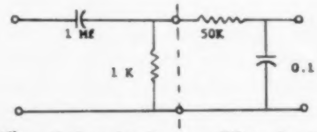


Fig. 1 Circuit changes for low-frequency response

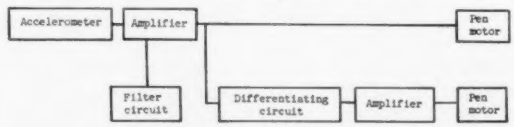
If the input terminals are connected to the pen motor terminals of the acceleration channel, the output voltage is a voltage proportional to the derivative of the input, or the desired "jerk". Actual test showed that considerable noise (random signals) was present in the acceleration amplifier output. To eliminate this from the jerk record a low pass filter was connected to the output of the differentiating circuit.



Differentiating circuit Filter circuit

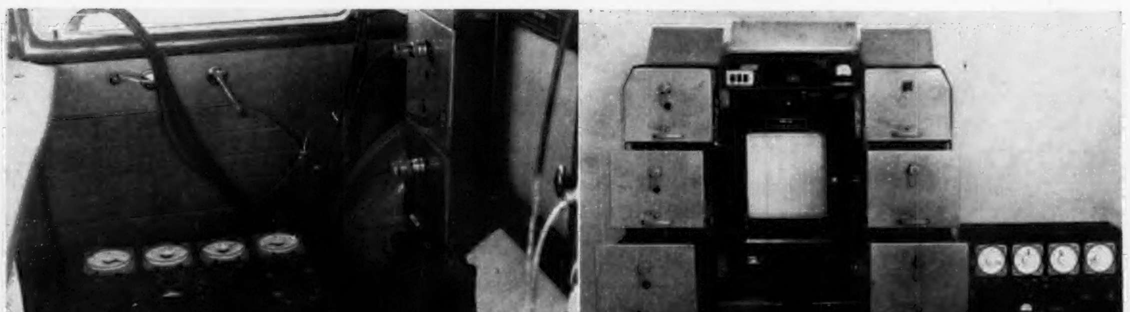
Another requirement of the above circuit is that the input impedance be large enough so that it does not overload the acceleration amplifier. It was found that a capacitor of 1 microfarad and a resistor of 1000 ohms were suitable.

Since e_{out} is very small, a Brush BL 932 amplifier is used to amplify the signal and record it on an adjacent channel. The following is a complete diagram of the system:



Calibration of Jerk Instrumentation

The calibration of this equipment is a problem unless either a vibration table or a low-frequency function genera-



Recording equipment in the station wagon consisted of a six-channel oscillograph, accelerometers and integrator control box

tor is available. In order to check the entire system including accelerometer, a vibration table is necessary.

If the acceleration section is known to be correct, then a low-frequency oscillator may be used to feed a constant known frequency to the final d-c amplifier of the acceleration channel. The gain may be adjusted so that the pen executes a representative calibration for measuring acceleration. If the amplitude and frequency of the acceleration-channel signal is known, then the magnitude of the jerk trace may be calculated. For example, set oscillator output for 3 cps and adjust gain of accelerometer amplifier so that the peak value of the resultant sine wave is 10 lines deflection. Assume that 10 lines represents 1 G of acceleration. In terms of a mathematical equation, then

$$\text{Acceleration} = 1G \sin(2\pi \times 3)t$$
$$\text{jerk} = 1G\ (2\pi \times 3) \cos(2\pi \times 3)t$$
$$= 6\pi G \cos(2\pi \times 3)t.$$

The amplitude of the jerk trace in the adjacent channel is $6\pi G$ per second. The gain of the jerk amplifier may be adjusted accordingly to give the desired magnitude of deflection. If the amplifier amplification for this condition is noted, then the calibration for any future operation may be readily calculated.

Test Procedures

Even though a jerk trace is available, there is still a need for a carefully planned program of testing in order to keep the evaluation on an accurate quantitative basis. The purpose of the testing will to a great extent govern the procedure used in setting up the test work.

If a frequency response check of a seat suspension is desired, then a vibration table is required and the use of jerk-measurement instrumentation will be desirable when the seat suspension introduces harmonics into the resultant vibration.

If a check of riding comfort is to be made using a tractor, then a test track with some form of permanent obstacles should be available. If minute changes in a suspension are to be made and evaluated accurately, or if reaction to certain types of bumps is to be studied, it is important that these variations be tested under identical conditions.

It has been found desirable to make three pairs of records of acceleration and jerk when testing a seat on a tractor. One record of tractor frame acceleration and jerk, a second record of seat suspension acceleration and jerk, and a third record of acceleration and jerk at the operator's shoulders or other body location. The acceleration record is of little value from a comfort standpoint; however, it will give evidence of nearness of operator being tossed from the seat.

The tractor frame record establishes the roughness of the course travelled and determines the consistency of the test track effect. It also permits an indexing to evaluate the effect of individual bumps. The measurement at the seat location will record the output of the seat suspension. The operator record will give the actual jerk experienced.

With the operator transducer location a great unknown enters which is difficult to evaluate. Proper placement of the pickup on the operator is a variable which has not yet been established. It is not precisely known just which part of the human body is the first to register discomfort. If this were known, then placement of the pickup near this location would probably be desirable. As a compromise, and assuming that comparative or proportional results are obtained, the pickup may be fastened rigidly to the operator in the vicinity of the shoulder blades.

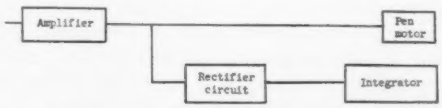
Another variable which accompanies the pickup location on the operator is the ability of the operator to sit stiff or to sit relaxed. A different record will result with the two postures. This is very undersirable and will nullify much test work. For some types of test the operator may be replaced with an equivalent amount of dead weight and a record of the effect of the seat suspension only will be available.

Use of Integrators

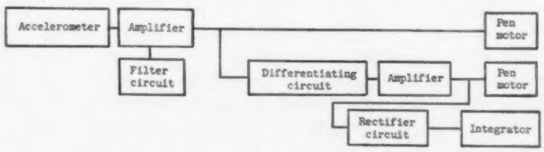
Another procedure, which utilizes electrical integrators, permits actual field testing of seating comfort. The use of electrical integrators in conjunction with a rectifier circuit produces an average reading of jerk magnitude over a period of about two minutes. With a tractor speed of 4 mph a distance of slightly more than 700 ft is covered. It is reasonable to assume that in this distance an operator can assume a natural composure. This will be especially true if a hundred feet or more is travelled before turning on the instruments. With this distance of run, and the taking of integrator readings, the actual terrain need not be as exact as when evaluating instantaneous values with runs of short duration. Thus a relatively uniform field can replace a test track.

The electrical integrators are instruments which give indirectly the area under the traces recorded. They are very simple in construction consisting of a moving coil in a magnetic field restrained from turning by means of a powerful magnetic dampener. The torque and resultant velocity of the moving coil is proportional to current input. The accumulated reading on the dial is proportional to current and time. If the time for a run and the integrator constant are known, the average current may be calculated. The integrators are connected to the pen motor terminals so that input current is proportional to pen deflection.

Since the jerk trace will contain both positive and negative values, the integrators if connected directly would be adding and subtracting continuously. With a full wave rectifier connected between the pen motor and the integrator, as shown in the following figure, the integrator will add both the positive and negative areas.



The following complete block diagram of the circuit is shown for one location of measurement.



At the end of a run, when the integrators are used, the average deflection or average value of jerk may be calculated by a simple slide-rule calculation. With the average value of jerk available from three different locations, the data may be set up in purely numerical form. For instance, the average

magnitude of jerk of the seat divided by the average for the chassis gives a constant which may be called the ratio of jerk reduction offered by that seat suspension. The average amount of jerk received by the operator divided by the chassis average jerk gives a ratio of the over-all reduction in jerk. If a sufficient number of replications are made, the comfort of a specific tractor seat may be expressed in numerical form.

Since there is a level of jerk which is considered "tolerable", another level considered "slight discomfort", etc. (according to Haack), it may be desirable to determine the average amount of jerk which exceeds a certain level. This is easily done by biasing of the rectifier so that no current reaches the integrator until the jerk pen deflection exceeds a certain value. This may be done by inserting an opposing voltage (Fig. 2) obtained from a battery in the output circuit of the rectifier. To adjust this bias, the recorder pen on the particular channel is deflected to desired cut-off value by unbalancing the amplifier. This sends a current through the integrator and may be observed on a meter connected in parallel (Fig. 2). Increase bias until this current is just zero. No smaller amount of current will reach the integrator.

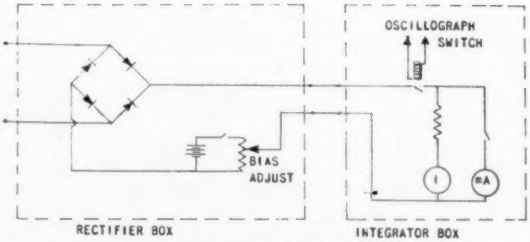


Fig. 2 Rectifier circuit

This bias procedure tends to separate two seat suspensions which have the same average amount of jerk. However, one would be in the tolerable zone much of the time, whereas the other might operate through quite a range of values and frequently enter the discomfort area.

As previously stated, this paper merely outlines a technique of instrumentation and many variations are possible. The information desired will establish how the test program is set up. It is believed that the field test with integrator readings described in this paper gives an objective answer in the measurement of seating comfort.

Simplified Procedure for Sampling Soil Moisture

Homer A. Weaver
Assoc. Member ASAE

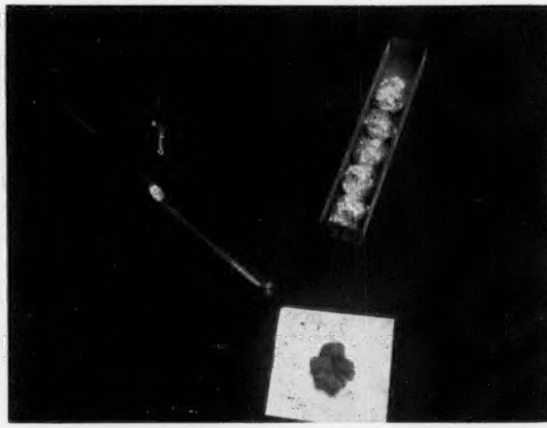
Aluminum foil replaces metal containers to simplify soil sampling

THE use of rigid metal containers for routine collection of soil moisture samples involves several tedious and time consuming procedures. Where precise results are desired, net soil weights may usually be determined only after subtracting container weights from gross measurements. Such containers must be individually weighed and marked, and, after using, must be cleaned. They usually become unserviceable after fifteen to twenty determinations and should be discarded.

The use of commercial standard weight aluminum foil to enclose soil samples instead of metal boxes recently has proved satisfactory in irrigation research underway in Alabama. Tests have been limited to collection of samples of 6-in length obtained with conventional tube type sampler, having a ¾-in diameter. The sample is placed in the center of a 6-in square sheet of foil and the corners are then pulled up together tightly to form a seal against loss of moisture. The sample thus enclosed is placed in a metal tray having sides high enough to prevent physical damage and wide enough to permit placement of a single file of four to six samples. Thus, several consecutive soil depths may be represented in orderly arrangement within a given tray. This procedure eliminates the necessity for individually marking each sample and requires only that the tray be identified. With reasonable care the samples may be moved safely from the field to laboratory for weighing. No measureable loss of moisture may be expected if the samples are weighed within 4 hrs after collection. Before placing in an oven to dry, the corners of the foil should be pulled away from the soil to allow moisture to escape.

Aluminum foil is uniform in weight, which allows for adjustment of laboratory scales to a common tare weight for all samples. This eliminates the necessity for computing net soil weights. It is recommended that direct reading scales sensitive to 0.1 gram be used where large numbers of determinations are to be made.

The present retail cost of aluminum foil is approximately one-fourth cent per 6-in square sheet. This low cost makes it possible to discard the foil with the soil sample eliminating the need for cleaning and storing.


Soil samples are wrapped in 6-in square aluminum foil for simplified handling

This article prepared expressly for AGRICULTURAL ENGINEERING in cooperation with the Alabama Agricultural Experiment Station.

The author—HOMER A. WEAVER—is agricultural engineer, Soil and Water Conservation Research Branch, (ARS) U.S. Department of Agriculture, Alabama Agricultural Experiment Station, Auburn.

Compaction Patterns of Smooth Rubber Tires

William R. Gill and Carl A. Reaves
Assoc. Member ASAE

Increased use of larger and more powerful farm machinery, and reports of decreases in crop and fruit production attributed to soil compaction, have caused engineers at the USDA Tillage Machinery Laboratory to conduct a research project for determining the relationship between the manner in which pressure is applied and the resultant soil compaction

THIS article is a report of a study which was conducted to determine the soil compaction pattern of experimental tires and correlate the compaction pattern with the soil physical properties as they are represented by laboratory determinations of static compressibility, shearing strength, moisture content and bulk density. Compaction was effected by two tires having widely different characteristics; one was a smooth 11-38 rubber tractor tire and the other a very large smooth, highly flexible rubber tire designed for military purposes—the Rolligon.

The smooth 11-38 tractor tire was selected to eliminate the uneven application of pressure to the soil by lugs. The tire was normal in all other respects and was operated on the tire testing apparatus at the USDA Tillage Machinery Laboratory, Auburn, Ala. This apparatus consisted of an Oliver Standard Model 70 tractor suspended in a frame which operated from the rails at the edge of the bin and allowed the tire under study to bear on the soil. It is described by Reed and Berry (1)*. Arrangements on the test car permitted the tire to be rolled freely as an unpowered transport wheel while the measurement of the draft required to pull the tire over the soil was recorded by a recording dynamometer.

The Rolligon, a large flexible elliptical-shaped rubber tire 60 in wide with a 42-in diameter, was designed as a flotation wheel to be used on snow or soft ground. This tire was supported at the ends by an axle which was coupled to the main supporting frame. Loading was done by weights carried in a box on rollers which rode on the tire. The rollers, mounted in frictionless bearings along the bottom of the box so that they were parallel with the long axis of the tire, transferred the weight of the box directly to the tire.

Paper prepared expressly for AGRICULTURAL ENGINEERING.

The authors—WILLIAM R. GILL and CARL A. REAVES—are, respectively, soil scientist and agricultural engineer, USDA Tillage Machinery Laboratory, Auburn, Ala.

Acknowledgment: The authors wish to express their appreciation to I. F. Reed for his assistance during the conduct of the study.

*Numbers in parentheses refer to the appended references.

Methods

Hiwassee sandy loam was selected for these compaction studies. The physical characteristics were based on the oven-dry moisture percentage as follows: one-third atmosphere tension, 8.0; 15 atmosphere tension, 5.4; lower plastic limit, 14.3; upper plastic limit, 16.6; and sticky point, 16.0. The mechanical composition of the soil was: Clay $<$0.002 mm 16 percent, silt 0.002-0.05 mm 10.9 percent and sands $>$0.05 mm 73.1 percent. The soil was repeatedly rotary tilled and showed little resistance to a probe to a depth of 17 in. In order to achieve a more dense soil and to remove inhomogeneous lines which occurred between adjacent paths of the rotary tiller, the soil was tilled at right angles to the direction of the rotary tilling to a depth of 17 in by means of a special cross-tilling device. Bulk density, moisture samples, and continuous penetrometer resistance measurements using methods described by Jamison *et al* (2) and Reed (3) were taken periodically to determine the uniformity of soil preparation. As a final operation the soil surface was smoothed gently by a straight-edged rail suspended from the cross-tiller car at the time of the last cross tilling. The smoothing caused an increase in density at the surface of the soil which was measured by sampling. The bin was divided crosswise into three sections and a plot of 70 ft long laid out in each sec-

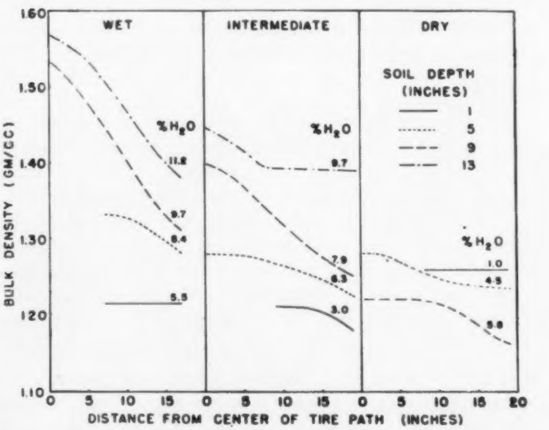


Fig. 1 Soil bulk densities resulting from compaction by 11-38 smooth tractor tire at three different moisture levels

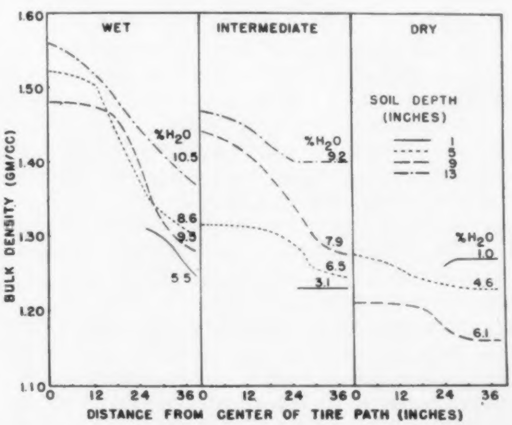


Fig. 2 Soil bulk densities resulting from compaction by the Rolligon tire at three different moisture levels

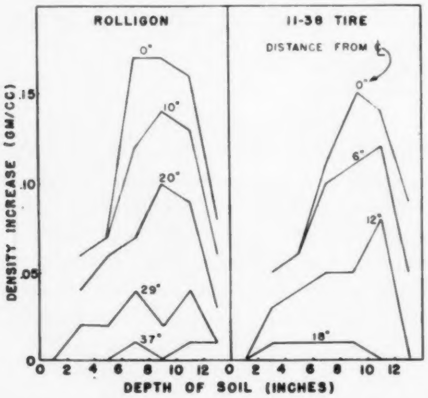


Fig. 3 The average increases in bulk density over the average original bulk density caused by compaction of tires

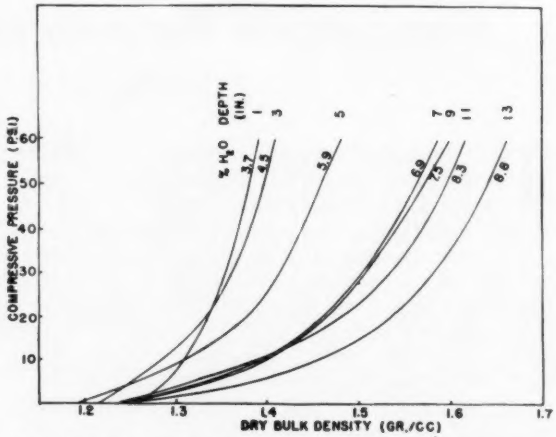


Fig. 4 Confined compressibility curves of the Hiwassee sandy loam

tion. The bin was covered between operations to prevent natural rainfall from altering the soil moisture. On August 5, 1955, the 11-38 smooth tractor tire and the Rolligon were each rolled over the soil a distance of 70 ft as unpowered transport wheels to compact the soil. Measurements were recorded as follows: For the 11-38 tire, tire pressure 12.00 psi, load on the tire 2440 lb, draft 290 lb; for the Rolligon, tire pressure 5.75 psi, load on the tire 500 lb, and draft 510 lb. The soil moisture was the driest of the three treatments at the time of compaction and averaged 1.0, 5.2, and 7.5 percent for the 1, 7, and 13-in depths.

On August 26, 1955, the two remaining plots were wetted throughout the profile by a sprinkler car application of 4 in of water to the surface of the soil. After several days, during which drainage took place, the soil was compacted on a second plot by each of the tires in the same manner as on August 5. The draft on this occasion was 380 lb for the tire and 685 lb for the Rolligon. The soil moisture of this plot was the wettest treatment and averaged 5.5, 9.3, and 11.0 percent for the 1, 7, and 13-in depths. The last plot was permitted to drain and evaporate moisture until October 12, 1955, when a condition of intermediate moisture existed. Compaction was again effected by the two tires and the draft was recorded as 275 lb for the tire and 485 lb for the Rolligon. The moisture content at this time was 3.0, 7.3, and 9.5 percent for the 1, 7, and 13-in depths.

In each case, before and after compacting the soil at each different moisture regime, measurements were made of bulk density and moisture. Samples after compaction were taken at 3-in intervals across the path of the 11-38 tire and at 2-in intervals downward to a 13-in depth. Sample sites were in quadruplicate for each regime of soil moisture. The Rolligon path was sampled starting at one edge and continuing across the path into a zone of non-compaction on the other side of the path. This sampling was also in quadruplicate at 3-in intervals and at 2-in intervals to a 13-in depth for each regime of soil moisture.

The greatest uncertainty was the estimation of the pressure which was applied to the soil by the tires. Because of the rigidity of the sidewalls, the internal pressure of the tire cannot be used as the contact pressure unless a tire has the flexibility found in the Rolligon. A device is not available to measure the pressures in the soil due to uncertainties which arise because of arching of the soil when a foreign body is introduced. As an indirect estimate of the magnitude of the pressures applied, the area of contact was measured for the tires on a rigid flat surface. The areas measured for the two tires in this manner were 136 sq in for the 11-38 tire and 912 sq in for the Rolligon. Considering the loads and the areas, the pressures applied to the soil by the tires would be 18.0 psi and 5.5 psi, respectively. It was recognized that the area of contact while the tire was rolling in the soil was quite different so that estimates of this contact area were made for the tires in the soil. The tires were rolled as usual, then stopped and quickly raised from the soil. The final impression was visible on the soil and the depth of the final impression was then measured on a horizontal grid system at ½-in intervals. Areas of contact of 213 sq in for the 11-38 tire and 1200 sq in for the Rolligon were measured on the soil at the intermediate moisture content. The average pressures applied by the tires as calculated from the loads and using these areas were 10.5 psi for the 11-38 tire and 4.1 psi for the Rolligon. These pressures were average pressures, since the pressure under the tire was not equal at all points of contact. For example, along the sidewalls there was contact but the vertical component of pressure carried by the sidewall was extremely small. It must also be kept in mind that the area of contact is a function of soil moisture and density. The draft measurements of the tires at each moisture regime reflect this difference to a degree.

Results

The application of pressure to the soil by the tires resulted in an increase in the bulk density, *i.e.* compaction of the soil. Compaction patterns are shown in Figs. 1 and 2 for each of the three moisture regimes. The greatest increase in density occurred directly beneath the tires and at the highest moisture content. In the case of the dry regime, the initial density of the soil was greater at the surface than at the lower depths. Compaction by the tire was not sufficient to change this condition. Irrigation of the intermediate and wet plots reversed this condition, presumably by transportation of some soil materials downward through the profile. The series of smooth curves in Figs. 1 and 2 represent graphically the average densities at each depth across the paths of the tires. The increase in density at each

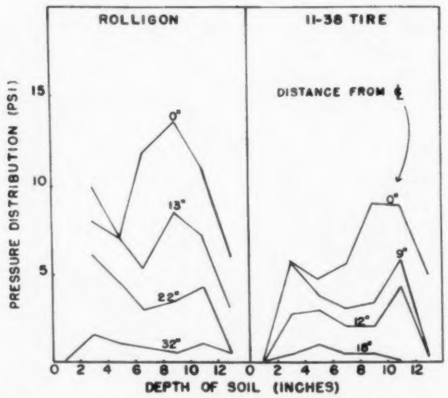


Fig. 5 Pattern of pressure distribution in pounds per square inch under tires as measured from soil compressibility measurements

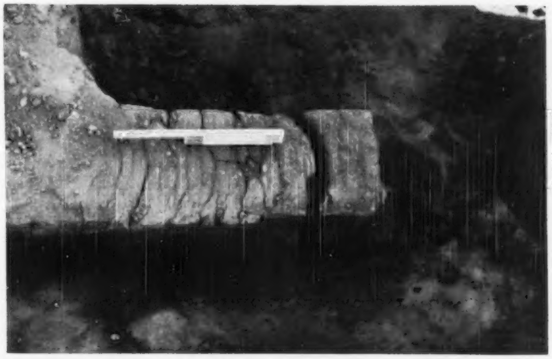


Fig. 6 Close view of cracks in the tire path showing the curved nature resulting from horizontal forces being applied to the soil by the tire. Movement of the wheel is shown from right to left

sampling site over the original density was then plotted in Fig. 3 and it was noted that a zone of maximum increase occurred in a band 7 to 11 in beneath the tires. While the results are shown only for the intermediate moisture regime, they reflect the general pattern of the other regimes.

It must be pointed out that compaction of the soil was caused by the total forces applied to the soil by the tire. In this case, other than the total load, the only major force was the horizontal force which was measured as the draft of the tire. The draft was a measure of the rolling resistance of the wheel on the soil. As a rule, slippage occurs between the tire and the soil whether the tire is being rolled freely as an unpowered transport wheel or whether it is powered. In either event there would be a tangential force applied to the soil, the direction depending upon whether the wheel was powered or unpowered. This force would also be effective in causing compaction. The pressures applied to the soil by the 11-38 tire have been estimated as 1.3 psi due to draft (275 lb draft/213 sq in area) and 11.0 psi due to load (2440 lb load/213 sq in area) making a total of 12.3 psi. For the Rolligon these values were 0.4 psi due to draft (485 lb draft/1220 sq in area) and 4.1 psi due to load (5000 lb load/1220 sq in area) totaling 4.5 psi.

The compressibility of the soil as determined by static confined compression tests in the laboratory on undisturbed soil cores taken from the plot at the time of the compaction of the soil at the intermediate moisture content is shown in Fig. 4. The nature of the curves indicates that increasing moisture contents resulted in increasing compaction for any pressure and that compaction was still taking place at pressures of 60 psi. These compressibility relationships were used in an attempt to evaluate indirectly the pressure required to compact the soil in the tire paths. This type of evaluation (Fig. 5) shows that a considerably greater pressure than that applied by the Rolligon caused compaction of the soil.

The importance of the horizontal compactive forces in the soil as well as the vertical forces can be shown by Fig. 6. A series of cracks, *i.e.* planes of weakness, are shown in the bottom of a tire impression made by the 11-38 tire on the wettest moisture regime. Similar cracks were found in the Rolligon impression but the spacing between the cracks was materially wider. These planes were created by the horizontal forces applied to the soil by the tires. With drying, the cracks became pronounced and were observed; however, their location marks incipient weaknesses in the structure which were caused by forces from the tires. Since the tires were used as unpowered transport wheels, the shape of the breach indicates that strain occurred in the direction of the movement of the tires at the rear of the tire-soil contact area.

Sohne has suggested (4) that the contact area of the tire be divided into 25 sections and that each section be assigned to bear a definite percentage of the load. The instantaneous pressures under a tire presumably occur in a pattern similar to that depicted by Sohne. However, in a final analysis a point in the soil beneath the tire is subjected to an increasing pressure until a maximum is reached; then the pressure decreases as the tire passes over that point in the soil. Considering the maximum pressure applied by the tire as the main compacting factor would then enable one to evaluate compaction without accounting for the instantaneous uneven pressure distribution under the tire since the rate of pressure application would be a constant for any given set of conditions. However, the entire stress pattern must be considered in the study of compaction at those points not under the center of the tire path.

The data shown in Fig. 5 also show that based on static compaction data it would appear that the pressure required to compact the soil immediately beneath the tire was less than that required to compact the zone 7 to 11 in below the surface. Laboratory measurements have shown that elastic rebound is extremely small in this soil. Deformation is therefore considered permanent and any small decrease in soil density caused by rebounding of the soil upon the removal of the applied pressures would not account for the irregularity of the apparent pressures. This situation could possibly be caused by more pressure in the soil beneath the tire which would prevent compression of the soil in that zone and transmit the pressure to greater depths. This seems an unlikely explanation for the dry and intermediate cases where the soil moisture was fairly low.

Since it is known from theory that the actual pressure must be greatest at the surface and that it must decrease with increasing depth, another possible explanation for the condition observed may be that the soil was loosened in some manner by the passage of the tire. Jamison *et al* (5) observed this to be true in the case of a powered wheel. This

could occur in an unpowered wheel as a state of shear progressing immediately behind the tire where the pressure was released from the soil. The shearing strength of the soil immediately beneath the tire would be at a maximum as a result of the forces applied by the tire so that it would support the load without movement. At the point where the tire would leave the soil, the shearing strength would be decreasing rapidly. Measurements of movement in the soil during the passage of a tire may assist in the solution of this question.

It would be highly desirable to relate the increase in soil density with the pressure applied to the soil by a tire and to be able to predict the amount of compactibility utilizing soil values such as shear, static compressibility, etc. The data shown in Figs. 1 and 2 indicate that the increase in bulk density due to the compactive pressures of the soil is dependent upon the position in the path of the tire as well as the depth. This possibly results from the different degrees of confinement experienced by the soil and the possible disturbance of the soil by the passage of the tire. The flat nature of the zones of equal density increase indicates that soil movement is generally downward but that some lateral movement does take place.

Since the density at any given point is affected by its location with respect to the center of the tire path as well as the depth, the effect of the area over which a unit pressure is applied to the soil should be studied as well as the magnitude of the pressure. Figs. 1 and 2 indicate that compaction under the Rolligon, where a lower pressure is applied over a larger area, is in general about the same as that under the 11-38 tire where a higher pressure is applied over a smaller area. The nature of the static compression curves indicate that compression continued to take place at a pressure of 60 psi, thus additional increases in load on either of the two tires should have caused additional compression of the soil. Bodman and Rubin (7) have shown that the soil density increased with shear as well as compression. Their data indicate that a more complete destruction of air-filled pores was achieved by compression plus shear than was achieved by compression alone. It is evident that additional studies will be required before unconfined shear and compression, as found under the dynamic conditions of compaction by a tire, can be correlated adequately with static compression and shear tests as performed by laboratory methods.

Osterberg (8) summarized work on the bearing capacity of soils that showed that size of the bearing surface was important as well as the unit load which was applied by the surface. Data indicated rigid circular bearing plates 10, 20, 30, and 40-in in diameter settled by increasing amounts under a given unit pressure. When the data were plotted in the form of unit pressure versus the ratio of settlement to diameter of the bearing plates, the curves of the 20, 30, and 40-in plates coincided and settlement in these plates was greater than that of the 10-in plate.

Considering increased settlement to be synonymous with increased compaction, it might be assumed that a maximum machine load and tire size may exist above which detrimental compaction would take place even though the unit load was reduced to what presently appears to be a satisfactory pressure. Stated differently, if a set minimum soil compaction is essential for economic crop production, design of heavy machinery may have to start with the load which can be borne by the soil without detrimental compaction rather than by starting with a load chosen on an engineering basis of power and weight which would have to be borne by the soil.

Taylor (6), discussing building foundations, has illustrated how a maximum in allowable bearing intensity of soil under a footing is related to the breadth of the footing for a given maximum settlement and how the maximum occurs at some intermediate breadth of footing. Data secured here indicate that in the case of a dynamic system such as a rolling tire, a similar relationship between the unit pressure and the area over which it is applied may exist. Establishment of such a relationship would provide a basis upon which to design machinery from a viewpoint of minimum soil compaction characteristics. The relationship would also provide a basis upon which to correlate soil compaction with soil physical properties as measured by shear and compressibility.

Summary

A study was made of the compaction patterns of two smooth rubber experimental tires in Hiwassee sandy loam. A smooth 11-38 tractor tire and a large Rolligon (military flotation type tire) were rolled over the soil at three different moisture conditions to compact the soil. Bulk density samples were taken on a grid pattern so as to secure the soil compaction pattern under each of the conditions. Many difficulties were encountered when attempts were made to relate soil compaction to the compactive pressures by tires to the soil. Measurement of the contact pressure is difficult and not yet satisfactorily measured; yet, given this pressure in the soil, other complicating factors remain.

At certain moisture contents the compressibility of the soil and the mechanical strength of the soil may vary due to pore pressures; hence, for any given compactive pressure, a series of densities and strengths could exist for any particular soil. It is also expected that the duration of application of the compacting pressure as influenced by the speed of travel would also affect the resultant compaction so that establishment of relationships is expected to be difficult. Movement of the wheel over the soil may cause a loosening of the soil. Attempts to relate instantaneous pressures measured under a tire with soil conditions existing after the tire has passed probably should take into consideration a record of the movements in the soil.

Soil compaction depends upon shear as well as pressure. When different degrees of confinement at different locations and depths under a tire, different amounts of compaction are expected for a given uniform pressure applied to the surface of the soil.

Soil compaction results from horizontal forces caused by thrust as well as from vertical forces caused by loading. The importance of the horizontal forces applied to the soil by the tires was reflected by a strain of the soil in the direction of the applied force. An estimation of the pressures applied to the soil by tires through simple load and contact area measurements was considered inaccurate since it neglected horizontal forces applied to the soil by the tires. Also, the pressure under the tire was not applied uniformly to the soil in the case of a normal rigid tire. It is possible that a maximum load and tire size exists for this soil, if *allowable* soil compactibility is to be used as a basis of tire design.

(Continued on page 684)

Soil Preparation for Meadow Crops

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IN THE preparation of soil for meadow crop production, the supplying of two needs is implied—a seedbed and a rootbed. To grow any crop the physical manipulation of the soil must serve two distinct ends: *(a)* provide a physical environment optimum for the germination of seed and development of the seedling, and *(b)* create a root zone having physical properties and behaviorisms favorable to root advance and to sustaining life and functioning capacity throughout the intended duration of the crop.

Unlike Requirements

Not unexpectedly, unlike crops require unlike seedbed specifications, and unlike rootbeds. Recognition of that fundamental implies the need of applying different tillage techniques or more or less intense manipulation of a given tillage process for purposes of fitting land for meadow crop as contrasted to tillage patterns for rowcrop culture or small grain culture.

Before setting about to manipulate the soil for purposes of germinating the seed or growing the plant, we need to recognize the requirement peculiar to meadow-crop species:

- A singular trait characterizing most, though not all, meadow-crop seeds is their smallness of mass and limited energy output in the seedling stage.
- With small size is limited surface area of seed with which soil material can make contact to induce germination. In like measure, the seed's minute charge of energy material means that the aerial member of the seedling can traverse only a thin covering of soil.

Both of these singular features of meadow-crop seed impose the need of refined and sharply adjusted specifications in the physical make-up of the seedbed. By contrast, these would obviously stand at the opposite extreme of a pattern optimum for corn, a large seed of extensive surface area and packed with much germinal energy capacity, in fact enough to drive its aerial shoot through three inches of soil in gaining emergence.

Paper presented at a joint meeting of the American Society of Agricultural Engineers and the National Joint Committee on Grassland Farming at Roanoke, Va., June, 1956.

The author—John A. Slipher—extension soil conservationist, Ohio State University and Soil Conservation Service, U. S. Department of Agriculture.

Soil properties and preparation methods are analyzed objectively in an effort to establish the "hallmark" of a correctly fitted soil for meadow crops

To behave properly toward the needs of meadow-crop seeds, a seedbed would need to have these specifications:

- Many and intimate contacts of soil with much of the seed surface in order to convey uninterrupted flow of moisture and heat.
- A consistency of the soil above and around the seed that permits unhampered emergence and development of the seedling.
- An unbroken contact with the rootbed in respect to continuity of moisture film, air ventilation, and penetrability for root advancement.

Of significance in connection with this paper is the recognition that the seedbed serves briefly—a few days only—but that this in no sense detracts from its essential function. The rootbed, on the contrary, must perform continuously throughout the life spar of the crop. In the case of meadow crops, that span is comparatively long as contrasted with the duration of the rootbed under commodity crops. There may be a causal connection between the disappointing short life of some meadow crops and attention to rootbed design. That question may merit investigation.

Soil Properties Basic in Processing of Soil

The texture, or size of soil particle, must be recognized as a fixed or unchanging property of soil. The more commanding feature, however, is the behaviorisms to which texture gives rise. Man cannot in normal management practices change the textural character of a given soil, but he can do much to modify some of the behaviorisms arising from this property.

Of great concern are *(a)* his selection of the type of meadow crop most applicable to the situation and *(b)* his design of practices appropriate to physically fit the site to the crop.

CHART 1 — RETENTION OF FIELD MOISTURE

6	5	4	3	2	1	7	8	9	0
weak, droughty		G o o d		F a i r		Choice	P r i m e		Strong

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Meaning of PROFILE NUMBER

Profiles

6 Immature soil; shallow; 16-18"; moisture capacity very limited.

5 Well-drained by underlying gravel or porous material; droughty.

Profiles

4 Desirable drainage; moderate moisture capacity; moderately deep.

3 Imperfectly drained; aeration slightly short of "par"; mild mottling.

Profiles

2 Poorly drained; aeration less favorable than in 3; more mottling; nutrients less available.

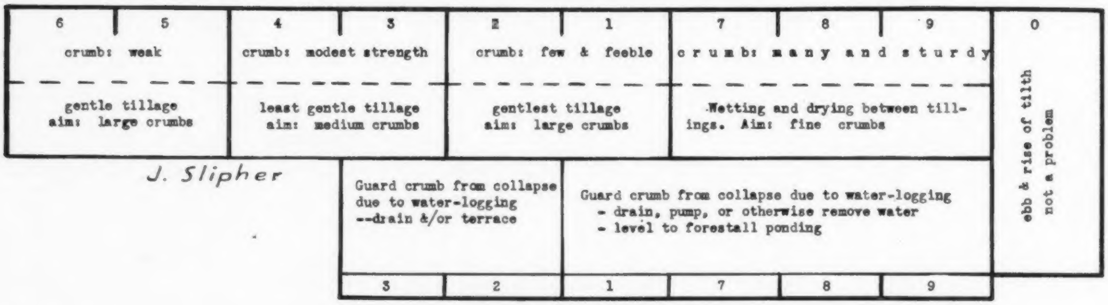
1 Each feature more acute than in 2.

Profiles

7 Dark
8 Darker
9 Darkest
THE CORN SOILS: excel in moisture capacity.

0 Organic -- peat or muck

CHART 2 — THE CRUMB AND ITS MANAGEMENT



Moisture content and its coexistent complement—air capacity—are dominated by texture. In fact, this relationship has long been appreciated by the tiller of the land in the well-established terms—"heavy soil," "light soil," "dry soil," "droughty soil." While these terms are broad and mark extremes of the moisture spectrum, the principle has been adopted in soil science to classify soils into useful and recognizable groups. On the basis of performance toward moisture, soils have been grouped into ten categories, known as the Bushnell "drainage profiles." These appear in the accompanying Chart 1. For convenience in ready usage, they are generally designated by numeral as shown in the chart.

On evaluating the several profiles for adaption to meadow-crop requirements one is impressed with

- The weak capacity of profiles 6 and 5, suggesting the advisability of a large ratio of deep-rooted legume to grass for such situations.
- The great retentiveness of profiles 7, 8, and 9, implying equal suitability to legume and grass.
- The intermediate capacity of profiles 4 and 3 would perform intermediate between the foregoing groups and the advisability of a larger fraction of grass than on profiles 6 and 5.

Modifiable Properties Basic in Physical Processing

Aside from moisture retentiveness, other major features are associated with each drainage profile, notably, aeration, denseness, and susceptibility to structuralization. Of these, we are most concerned about the last—structure. These three the farmer can modify, very substantially in most situations. His results can be good if the effort is based on design and carried out objectively. His experience in modifying soil physically may be and, likely will, be bad and disappointing if his management fails to follow the limitations inherent in and imposed by the weakness of the particular soil involved.

It is not amiss at this point to mention that, while the title of this paper does not imply it, actually the duty of soil manipulation is primarily to utilize the structure potential of soil to set up a root environment that best favors the plant.

Structure, Tilth, and Tillage

In a soil mass it is normal for soil particles to cling together in small clumps. On breaking the mass apart, it separates out into crumbs. The components of the crumb are individual mineral particles (and organic matter fragments) held together with weak and strong cohesion force. That force may arise from salts or coagulated colloid or humus. The crumb is the unit of structure.

Susceptibility to structuralization varies as between soils. The greatest capacity to form a crumb unit is associated with soils possessing high collodial content, high humic content, a goodly lime content, good aeration and drainage, a liberal content of the clay separate. Soils of poor drainage, dominantly sandy, dominantly silty with absence of clay fraction are virtually structureless. Of worse concern is the fact that there is no means by which they can be induced to acquire structure.

By and large, the power to develop crumb structure varies as between drainage profiles (see upper section of Chart 2).

Good structure makes possible good tilth. The two traits are not synonymous; nor does good tilth follow automatically from good structure. Tillage supplies the needed force to yield good tilth out of good structure. Tillage itself creates no crumbs but is the means of rearranging them to provide good tilth.

Agencies Causing Formation of Crumbs

In his manipulation of the soil the farmer may utilize or work through or concurrently with the following agencies to create structural crumbs:

- *Alternate wetting and drying.* On drying, wet soil shrinks, the moisture film rupturing along planes of weakness in the mass. If there exists many such planes, there will arise many centers of contractions and correspondingly numerous granules. Repetition of the alternating process will ultimately reduce a hard stubborn clayey soil to a friable state. The binding grip of attendant colloids, or salts, or lime play a part by hardening the crumb.
- *Addition of organic matter.* Adding organic matter creates crumb formation. Leachings from the raw material or the humus from decay effect granule formation. Striking evidence of this is the prevailing good crumb structure found in profiles 8, 9, 0. Profiles of scant organic matter content need to be stuffed with heavy charges of humus-making material during the cropping cycle.
- *Alternate Freezing and Thawing.* A process that shatters the soil mass but impossible to harness for good.
- *Action by Roots of Sod Crops.* By far the strongest agent creating structural crumbs are the roots of sod crops. Just how live roots cause crumbs to form is not evident. Legume roots affect structure throughout a deep mass; grass roots are confined to the upper

CHART 3 — RECEPTIVITY TO RAINWATER (Assuming Soil in Normal Tilth)

6	5	4	3	2	1	7	8	9	0
rapid;	greedy;	m e d i u m;		r e s i s t i v e;		excels 4	o p t i m u m;		
loses rate slowly	rate nearly constant	deceleration delayed		adsorption decelerates r a p i d l y		but below 8	deceleration negligible		
Corrugate surface contourwise by tillage									

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plow layer but their action is intense. Grasses yield finer and more rugged crumbs than do legumes. Cropping cycles having frequent and vigorous sod members offer promise of superior seedbed and rootbed when the land is again fitted for establishing a meadow crop.

The Tilth Cycle

Structure once created and tilth once established do not endure. Aging and deterioration set in early and continue until arrested. Ebb follows rise in a cycle. Weak crumbs succumb quickly and strong crumbs slowly to certain damaging forces. Among them may be cited prolonged or excessive rains, ill-suited tillage, defective drainage, impact of raindrops, and just plain aging—burning away of humus and the softening of colloids.

Symptom of trouble shows first in the collapse of the fragile crumbs and extends to stronger ones in time.

The hope of achieving good quality of crumb and superior tilth rests basically upon the potential inherent in the kind of soil. (See profile patterns aligned in Chart 2.) It is characteristic for some soils to give rise to weak crumbs; others to ones of sturdy quality. Then too some profiles yield few, others many crumbs, however active may have been the creating agencies.

Optimum Manipulation

In the fitting of seedbed and rootbed, the vulnerable nature of the crumb needs to be recognized. In the instance of soils in which the crumb is constitutionally weak, the tillage manipulation needs to be mild, infrequent, and sharply adjusted to the suitability of moisture content. For others more force, aided by alternate wetting and drying, may prove proper. What constitutes optimum manipulation and the advisable size of crumb are set forth in comparative fashion in Chart 2.

Protect Durability of Crumb and Tilth

Aimless and needless jostling of crumbs by tillage split and wear away the unit and shorten its useful duration. Concurrently, the fluffed up condition of tilth which rests on the "bridging over" position between crumbs and particles tends to collapse leading to consolidation of the soil mass.

Of the infirmities besetting the crumb, the damaging effect of water is one the farmer can do most to soften. On soils prone to water-logging (notably profiles 3, 2, 1, 7, 8 9) providing facilities to remove excess water or to forestalling its local accumulation are pertinent precautionary measures. They are no less valuable for meadow-crop sites than for those devoted to commodity crops (Chart 2).

Systems of Fitting Soils For Meadow Crops

In selecting systems for preparing seedbed and rootbed for a meadow crop, the necessity is that of evaluating each in terms of the foregoing principles and of relating them to soil situations.

Manipulation in Trash-Mulch Method. Starting with a situation possessing some vegetative cover of undesirable species, the trash-mulch method may be employed to establish a long-time type of meadow. Manipulation of soil is confined to a relatively shallow layer. Its purpose is to terminate the life of existing species by separating the roots from the soil, and, in the operation, to avoid incorporating the plant material and debris deeply in the soil body, leaving most of it as a mulch or semicovering topping the well-loosened seedbed.

Its success and virtue lie in two features:

- Capitalizing on the soil layer bearing the concentration of soil crumbs produced by the roots of vegetation. The objective is not to bury them under raw soil by inversion, but to keep them in the upper few inches.
- Employing the fragments of debris material to shield the crumbs against churning action of raindrop impact and stay moisture against evaporating at the seed level.

Not all land situations lend themselves to the use of the trash-mulch method. While proving effective on the lighter-textured or less tenacious soils (as in the instance of profiles 6 and 5) one meets with difficulty where soils possess much body. Appreciable clay content or strong moisture retentiveness pose difficulties. Separating soil from live roots is not easily effected even with repeated operations, resulting in a poor "kill". Experience demonstrates the undue expenditure of power and the severe mauling suffered by soil in such situations. Plowing and conventional processing prove more appropriate.

Furthermore, the trash-mulch operation does nothing to improve the rootbed physically. For the "light soils" that failure causes little or no shortcoming because of little or no need for it. But for soils of "body," its omission can not be ignored.

Preparing Soil For Summer or Open Seeding

In preparing soil for summer seeding or seeding in the absence of a companion crop, the farmer has more freedom in applying processing techniques to effect the right results, for rootbed as well as seedbed. It will be conceded that more planning and effort in execution are involved in this method. However, if the outturn in meadow crop lives up to expectation, these expenditures are not disproportionate.

To build rootbed for bare land seeding either in summer or spring calls for plowing or comparably deep manipulation. It is a single-purpose function: to disengage the crumb units one from another. Subsequent application of soil-working implements may further the action. The jostled and fluffed-up soil mass provides commodious interspace between crumbs, which fit loosely against neighbors. It is this "elbow room" that favors unhampered advance

of growing roots, that circulates atmospheric oxygen well beneath the soil surface, and that soaks up rain water and quickly conducts it to deeper zones.

The extent to which different soils can adsorb rain water varies widely. (See Chart 3 for relative performance typifying soil groups.) Through building friableness and setting up stable open tilth, the farmer can do much to prolong receptivity.

A rootbed best fulfills its duty toward the requirements of a meadow crop if its tilth and consistency are made relatively open and coarse.

On the contrary, small crumbs function best in the seedbed since they alone fit snugly around the seed at numerous points. Dust, which is individual soil particles, ill-serve the function, being prone to crust and thereby excluding air and water as well as blocking emergence. A progressive merging of seedbed into and with the rootbed insures continuity of moisture film between the two. Survival of the seedling depends sharply on an unfailing moisture connection with a reserve in the upper rootbed. Otherwise, having frequent enough rains to replenish the moisture carried solely by the seedbed is a large risk. In fact, it is well to enhance the safety further, by corrugating the surface contourwise by tillage to trap rainfall on slopes thus conducting it into the soil at the bottom of the V. A further good practice is the use of a thin screen of straw or manure as a barrier against surface evaporation. This measure is equally applicable to grooved slope and level sites.

The manner in which a soil-working implement applies force to the soil body measurably affects *(a)* how well it forces the crumbs apart along the existing planes of cleavage and *(b)* the quality of tilth set up. The plow correctly operated upsets the balance of forces in all parts of the furrow slice.

Fitting implements do most good in developing tilth and less harm to crumb, *(a)* if their action is of the lifting type and *(b)* if applied after the crumb has been permitted to "mature" or "harden" by drying following the plowing operation. Implements exerting compression action shatter crumbs and undo tilth—not build it. Any operations that produce a sharply defined stratum within the plow layer need serious questioning.

Preparing For Seeding With Companion Crop

To plan a most favorable seedbed and rootbed opportunity for a meadow crop to be seeded in a companion crop of small grain one would need start a year in advance of the intended seeding.

Most could be achieved by choosing a site that offers good soil structure, such as a clover sod. If the companion crop were to be winter grain, seeded to a meadow crop the following spring, here then exists the only opportunity to build a rootbed. No better opportunity can be found to put meadow-crop roots in an environment of superior crumb and tilth development.

The tillage processing, following plowing well in advance of grain seeding, needs to be of a non-vigorous kind, depending chiefly on rains to do most of the consolidating effect in preparation for starting the small grain crop.

The carry-over of structural units into spring would simplify the fitting and enhance the quality of the seedbed needed for the meadow-crop seeding. Drying of the soil surface to the point of lending friability to the seed layer should invite mild agitation by implement: rotary hoe or soil packer, if seed are to be broadcasted; grooving the friable layer by disk or drill or other soil-working implement, in the case of drilling the seed. The loosened material becomes the seedbed. It is here too that rain water will enter more readily and in greater proportion.

Compaction Patterns of Smooth Rubber Tires

(Continued from page 680)

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Super Plant Growth Stimulant Tested

AN announcement has been made by Eli Lilly and Co. of Indianapolis, Ind., that a promising chemical—gibberellic acid—has been under investigation for potential agricultural and other uses. The chemical has been studied as a plant growth stimulant in both climate-controlled laboratories and under field conditions. Under laboratory conditions, gibberellic acid has increased the growth rate of some plants by five times.

Gibberellic acid is obtained from cultures of a fungus called Gibberella fujikuroi. Technically, the chemical is tetracyclic dihydroxylactonic acid. To the present time, production problems have made it impossible to obtain a sufficient quantity of the chemical to supply even research requirements. However, Eli Lilly and Co. has been successful in producing a quantity of pure gibberellic acid. This material is being distributed to scientists at agricultural colleges and other institutions in the interest of obtaining more information about this promising plant growth stimulant and growth regulator.

In past experiments, gibberellic acid has been shown to stimulate growth in field crops such as wheat, oats, clover, the grasses (including corn), and tobacco. It has also speeded growth in vegetables, ornamental flowers, shrubs, and even trees. Besides speeding growth, it reportedly has other potential uses. In scientific experiments, it has been shown to break dormancy in specific plants, to stimulate germination in certain seeds, to reverse dwarfism, and to induce flowering of biennials in the year in which they would not ordinarily flower.

Under controlled conditions, gibberellic acid has been applied successfully by spraying onto leaves, fed through the roots, injected into the stem, and rubbed onto the stem as part of a lanolin paste.

TECHNICAL PAPER ABSTRACTS

Following are brief reviews of papers presented at ASAE meetings. Information concerning complete copies of these papers may be obtained by writing to the American Society of Agricultural Engineers, St. Joseph, Mich.

Navy Grounds Maintenance, by Lawrence E. Tull, head, grounds and ground structures section, facility branch, maintenance division, Bureau of Yards and Docks, U.S. Navy Department. Presented at the annual meeting of ASAE in Roanoke, Va., June, 1956, on a program arranged by the Soil and Water Division. Paper No. **56-26.**

This article reviews the responsibility of Bureau of Yards and Docks, U.S. Navy, for technical control of the grounds maintenance of the entire naval shore establishment plus other maintenance and repair functions. This establishment includes installations all over the United States, and in many parts of the world overseas. The maintenance of these grounds includes conservation of open lands and cantonment areas, the protection of engineering works, combating the injurious effects of erosion and floods, and maintaining them in a condition suitable for their intended use. The Navy also has many waterfront facilities which involve erosion and silting problems.

To help the field, guidance is supplied by direct correspondence and through printed matter. Publications include: Technical manuals; BuDocks instructions and notices; and maintenance supplements in the monthly *Technical Digest.* Technical assistance on special problems is available from the specialists employed by the District Public Works Offices, as well as from the Bureau of Yards and Docks.

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The Place of Irrigation in Grassland Farming, by W. A. Raney, department of agronomy, Mississippi State College, State College. Presented at the annual meeting of ASAE in Roanoke, Va., June, 1956, on a program arranged by the National Joint Committee on Grassland Farming. Paper No. **56-29.**

Based on climatological investigations the author points out that droughts occur with sufficient frequency and intensity to limit crop production throughout the Eastern half of the United States. Drought damage may be reduced by more efficient use of existing rainfall and by irrigation. This paper reports on a study to determine economic returns from irrigation. Results indicate that returns are greatest when irrigation is used to control establishment of new forage seedings and for subsequent irrigation of forage species that use water efficiently.

Under comparable conditions in Mississippi, an increase of one ton of forage from irrigation required 7.5 acre-inches of water for a pasture, 2.7 acre-inches of water for a hay meadow and 1.9 acre-inches of water for millet and sudan grass in rows. Corn and sorghum silage required approximately one acre-inch of water per ton. These data strongly suggest that the use of irrigation as a production practice should be limited to the control of rate of establishment of pastures and hay crops and only in the production of supplemental feed crops and silage. These data do not preclude the use of irrigation on pastures and hay crops providing water costs can be lowered primarily by cheaper means of application.

Establishment of Forage Crops, by J. L. Haynes, agronomist, Ohio Agricultural Experiment Station, Columbus. Presented at the annual meeting of ASAE in Roanoke, Va., June, 1956, on a program arranged by the National Joint Committee on Grassland Farming. Paper No. **56-27.**

The tools and arts appropriate to the culture of forage crops are stressed in this article. Uniform emergence and rapid early seedling growth were covered as first objectives for forage crop seeding operation. Favorable conditions necessary for early germination, uniform germination, and uniform emergence, were discussed.

For rapid seedling growth the author reports that all the seed, not just part of it, should be placed about 1 inch above a band of fertilizer. For nutritional starter effect, the first seedling root must enter the fertilizer band. The need for obtaining accurate fertilizer metering, uniform delivery, depth and position with respect to seed placement will become still more essential. As a device for restricting the area of favorable seedbed preparation and starter fertilizer placement to the forage seed, and to deny this advantage to as many weed seeds as possible, the seed with its starter fertilizer should be in rows. These rows need not be closer than 8 in apart, but should not be more than 10 in apart.

The author states that sufficient agronomic information exists to specify machinery functions which will promote uniform germination and rapid early seedling growth as a part of the seeding operation. However, tools suitable for the application of these arts remain to be developed and distributed before our farmers can seed forage crops with the same degree of consistent success now enjoyed with modern equipment for seeding grain and fiber crops.

•

Removal of Silage from Horizontal Silos, by Merle L. Esmay and Donald B. Brooker, respectively, associate professor of agricultural engineering at Michigan State University, and University of Missouri. Presented at the annual meeting of ASAE in Roanoke, Va., June, 1956, on a program arranged by the National Joint Committee on Grassland Farming. Paper No. **56-28.**

Removal of silage for feeding purposes from a permanent type horizontal silo in regards to management engineering is covered in this paper. The authors point out that in the past five years the improved permanent type horizontal silo with concrete floor and stabilized side walls has evolved from the unlined trenches and unprotected stacks which were and still are being used to some extent for emergency storage of forage crops. Mechanical equipment such as tractors and scoops are now available on most farms for removal of silage and much more is known about self-feeding techniques.

Self-feeding silage from a horizontal silo is said to require a minimum of labor on the part of the operator, but does need good management for maximum satisfaction. In the first place, proper planning for a self-feeding operation is necessary. The design and control of the self-feeding gates are critical in successful operation of a self-feeding program. Where a self-feeding operation or the use of tractor and scoop is anticipated, the following physical specifications of horizontal silos should be incorporated for best results; convenient location; permanent floor of 4 in of concrete or equivalent; side walls of rigid, durable air-tight material having a minimum slope of 1 in horizontally for each foot of rise; drainage of the silo to the open end of 1 ft of fall in 50 ft of length; and minimum width of 16 ft and depth of not over 7 ft.

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Electric Underheat Brooder, by Harold T. Barr and John H. Hough, respectively, head, agricultural engineering department, Louisiana State University, and agricultural engineer, National Lumber Manufacturers Assn., New Orleans, La. Presented at the annual meeting of ASAE in Roanoke, Va., June, 1956, on a program arranged by the Rural Electric Division. Paper No. **56-30.**

This paper reports on a search for a brooder that could be moved easily, convenient to inspect, require as little supervision as possible, be fire safe, low in operating cost, and designed so that it could be built by the farmers from materials readily available locally.

The infrared lamp brooders proved economically disappointing in most cases due to lack of adequate controls and fairly high operating cost. Underheat brooding was being used successfully by some operators who were heating a section of a concrete floor by hot water pipes, or by electric soil heating cable. The high initial cost and permanent floors were objectionable to many operators.

The final L.S.U. underheat brooder for 350 chickens consists of a portable 1⅝-in thick x 48-in wide x 72-in long floor covered by a 48-in square aluminum hover. A 400-watt capacity, 60-ft soil heating cable is formed to a flat grid in the central 48 in of the floor. The bottom of the floor is insulated to prevent loss of heat to the ground. By filling around the cable with sand the heat is held for approximately two hours in case of power failure. An aluminum pyramid or oval type hover in place of a flat wood or fiber board reduces the cost of operation by 20 percent.

A test just completed compares this type of underheat with two butane brooders and one Merco tube infrared brooder. The test covered four brooding periods, viz., winter, spring, summer and fall. Conditions of brooding other than the type of brooder were exactly the same.

Type of Brooder	Average cost per bird	Percent ratio cost
Merco tube infrared	2.32 cent	100
Butane	1.55 cent	67
Butane	1.39 cent	60
L.S.U. underheat brooder		
No. 1	0.69 cent	30
No. 2	0.59 cent	25

Electricity at 2 cents per kwh

Butane at 14 cents per gal

Results to date indicate that sufficient heat to promote bird comfort under Louisiana conditions can be obtained from a portable underheat brooder similar to the one described in this paper, utilizing approximately one-half the amount of heat needed in the conventional overheat type of brooder and approximately one-third as much heat as would be needed if infrared lamps were used.

(Continued on page 686)

READERS' FORUM

Following are letters in which our readers have expressed opinions, suggestions, unusual experiences, or divergent views on subjects of an agricultural engineering nature. It is the intention of the editor to publish a few such letters in each issue of AGRICULTURAL ENGINEERING to encourage free expressions and open debate on pertinent and timely topics.

Suggests Standards for Sprayers

TO THE EDITOR:

The AGRICULTURAL ENGINEERS YEARBOOK, 1956 edition, has just come to my desk. This is an interesting, enlightening, useful document to have on hand.

As I leafed through the sections on Standards, Recommendations, Codes and Data, I noted that apparently no standards have been established for any type of spraying equipment.

Spraying equipment has always been important not only in agriculture, but in public health activities as well. The agricultural engineer must appreciate this in practically every phase of agriculture where soil insects and animal biting and annoying insects play such important roles in both crop production and crop destruction. Such equipment plays an equally important part in human welfare by controlling or eradicating insect pests detrimental to the health of mankind.

It is in this latter field that the writer has been occupied for more than the last quarter century. Control of mosquitoes and eradication of malaria through use of spraying equipment goes forward on an enormous scale throughout the world. In the United States, mosquito abatement districts are found everywhere. Fortunately malaria has been eradicated from the United States, and spray equipment has played a major part in this work. Other countries scattered throughout the tropics and subtropics are carrying on public health programs which look forward to malaria eradication as well as to control of other insect-borne diseases. Spray equipment must play a leading part in any of this work.

It seems logical, therefore, to establish certain minimum specifications or requirements for guidance of the purchasing or user agency of such equipment. This is being done in the public health field. World Health Organization has a standing committee which has drawn up standards for types of sprayers and dusters used in this field. The writer is a consultant to this committee. Standards have been established and revised at special committee meetings over a period of years since 1948. These specifications are now used as guides to requirements both by makers and by user agencies of equipment throughout the world. Even American manufacturers pay attention to these specifications when foreign shipments, usually sponsored by U.S. Technical Aid purchases are considered. The standard of such equipment has been notably raised since this committee came into existence.

It would appear that the American Society of Agricultural Engineers would be the logical body to sponsor a similar committee, one perhaps with a broader base than the W. H. O. committee, which would establish fundamental principles to be followed in spraying and dusting equipment design. Furthermore, it is believed the ultimate user agency, be it farmer, pest control operator or public health agency would appreciate the value of such technical information, compiled by an independent and reliable agency. You would be assured this is true if you were handed some of the eccentric pieces of spraying equipment (from the United States) which has come into the hands of the writer under conditions where W. H. O. specifications were not mandatory.

FRED W. KNIPE

Malaria Institute of India
22, Alipore Road
Delhi 8, India

Editor's Note:

This letter shall be submitted to the proper committee of ASAE for due consideration.

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Urges Tillage Mechanics Study

TO THE EDITOR:

I was interested to read of Australian work on the mechanics of tillage in your July, 1956, issue and am glad to hear that this much-neglected topic is receiving attention in that continent. Some of McClelland's results appear quite important, particularly the rhythmic variation of "probe" draught, but the paper emphasizes once again that workers on soil tillage are still reluctant to make anything like fundamental tests of the mechanical properties of soil. In spite of its advantages as regards sampling procedure, the probe still has the main disadvantage of the penetrometer, Scott Blair's compression test (1)*, Keen's rigidity test (2), Carena's dynamometric coulter (3), etc., that it measures the combined effect of several of the soil's mechanical properties, and in different proportions from soil to soil.

Surely what is needed for the study of the mechanics tillage are measurements of the relevant mechanical properties (4) of the soil, viz: shearing resistance, sliding resistance over a "foreign" surface and bulk density. Each of these can be measured satisfactorily in situ and are of direct meaning to engineers (5), and are in manageable units.

If the "probe" could assess the quality of a soil as a plant root environment, it might be classified with the Brinnell test for metals, as a useful empirical guide, otherwise it is difficult to see any application for the test or others of its type.

E. R. FOUNTAINE

National Institute of Agricultural Engineering
Wrest Park, Silsoe, Bedfordshire, England

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Technical Paper Abstracts

(Continued from page 685)

Farm Structures Research Needs, by Wallace Ashby, Agricultural Engineering Research Branch, ARS, USDA, Beltsville, Md. Paper presented at the annual meeting of ASAE at Roanoke, Va., June, 1956, on a program arranged by the Farm Structures Division. Paper No. **56-32.**

This report contains results obtained from a questionnaire that was sent to heads of agricultural engineering departments at agricultural colleges and about 50 others, including USDA employees, representatives of industry and individual research workers and extension men.

Tabulation of 66 replies to a question regarding relative importance of fields of farm building research placed livestock buildings first; crop storage, second; and materials and construction methods, third. Replies to questions regarding the relative importance of functional problems rated more effective use of labor (including materials handling), first; environmental requirements and control, second; and lower construction and maintenance costs, third.

Farm buildings research now being carried on by state experiment stations and the USDA Agricultural Research Service places most emphasis on studies of environmental requirements and control in livestock buildings. Grain and seed conditioning and storage are second, and materials and construction methods third. The replies were interpreted to indicate need for a shift in emphasis, with more attention given to studies of how to save labor in farm buildings and around the farmstead.

Also reported are 94 research projects on farm buildings in 42 agricultural engineering departments with 53.8 professional man-years devoted. The Agricultural Engineering Research Branch reported 34 research projects and 35 professional man-years. Together the state agricultural experiment stations and the Agricultural Engineering Research Branch in 1955 spent $1,120,000 on farm buildings research, equivalent to 23 cents per farm. By way of comparison, farmers have an investment of about $5500 per farm in buildings, and spend about $300 per farm per year on new construction.

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Land Forming and Smoothing — For Efficient Production, by T. W. Edminster, agricultural engineer, Eastern Soil and Water Management Section, ARS-USDA, Beltsville, Md. Presented at the North Atlantic Section of the American Society of Agricultural Engineers in Ithaca, N.Y., August, 1956. Paper No. **56-34.**

Recognizing that full agricultural production efficiency depends on a process of land conditioning that will provide field conditions suitable for maximum efficient and effective mechanized agriculture, the author explains how land forming and smoothing make drainage and irrigation more effective. In support he reminds us that a uniform surface permits higher speeds in planting, cultivating, and harvesting; and that greater precision is achieved in each of these operations when the implement scars, depressions, headlands, rocks, and other obstacles are removed. Data shows extensive land use conversions are being made in the Northeast to provide more suitable land use. Data also show extensive construction of diversions, terraces, drains, and other "land conditioning" practices.

NEWS SECTION

Agricultural Engineers Officiate at National Plowing Matches

SEVERAL agricultural engineers served as officials for the 1956 National Plowing Matches held on September 21 and 22, on farms near Prairie City, Iowa. ASAE Secretary Jimmy L. Butt served as an official scorer, and other ASAE members, John Ferguson, Kansas State College; Ted Willrich, Iowa State College; A. J. Wojta, University of Wisconsin, and A. J. Schwantes, University of Minnesota, acted as official judges. Dale Hull, Iowa State College, served as a contest director, and was also in charge of the level land contest, assisted by Gene Shove of Iowa State. Members of the rules committee included Ray Armstrong, Iowa State College, and Robert Gilden, Federal Extension Service, Washington, D. C.

Approximately 350 tractors with related equipment as well as fertilizer, electrical, farm structures, seed and other displays occupied the perimeter of the square-mile tent city.

The plowing matches were attended by an estimated 100,000 persons. President Dwight D. Eisenhower and Presidential Candidate Adlai E. Stevenson addressed the group on separate days. First place in the level land plowing contest was won by Lawrence Goettemoller of Salina, Ohio.

EEI Elects Farm Group Chairmen

THE Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y., has announced the election of the chairmen for the farm group of the commercial division to serve for the 1956-57 committee year.

M. O. Whithed, rural supervisor for the Atlantic City Electric Company of Atlantic City, N. J., was chosen as chairman of the farm group. P. R. Schepers, Consumers Power Co., Jackson, Mich., will continue to serve as chairman of the farm sales promotion committee, and Lamoyne Goodwin, Gulf States Utilities Co., Beaumont, Texas, will serve again as chairman of the rural youth committee. All three are members of the American Society of Agricultural Engineers.

E. R. Murphy, Kentucky Utilities Co., Lexington, was elected chairman of the farm utilization committee, and Burwell Smith, Carolina Power and Light Co., chairman of the agricultural development committee.

The chairmen have selected the personnel for their committees from power companies throughout the United States and plans are now being made for an organization meeting of the farm group where the type of projects that should be carried out during the coming year will be determined.

ASAE Meetings Calendar

October 11, 12—ALABAMA SECTION, Hotel McDonald, Winfield

October 13—MICHIGAN SECTION, Michigan State University, East Lansing

October 18, 19—PENNSYLVANIA SECTION, Erie

October 19, 20—VIRGINIA SECTION, Jefferson Hotel, Richmond

October 24-26 — PACIFIC NORTHWEST SECTION, Penticton, British Columbia

October 26, 27—OHIO SECTION, Ohio State University, Columbus

November 16—QUAD CITY SECTION, Rock Island Works, J. I. Case Co.

November 16, 17 — TENNESSEE SECTION, University of Tennessee, Knoxville

November 30—OKLAHOMA SECTION, Student Union, Oklahoma A. & M. College, Stillwater

December 9 to 12 — WINTER MEETING, Edgewater Beach Hotel, Chicago

December 27, 28—PACIFIC COAST SECTION, University of California, Davis

February 4-6 — SOUTHEAST SECTION, Birmingham, Ala.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

1956 Winter Meeting

THE 1956 winter meeting of the American Society of Agricultural Engineers will be held December 9, 10, 11 and 12 at the Edgewater Beach Hotel, Chicago. The executive committees of the Society's four technical divisions — Power and Machinery, Soil and Water, Farm Structures, and Rural Electric — presently are in the process of completing arrangements with prospective speakers for what promises to be a most interesting and informative program.

Advance registration cards and hotel reservation forms will be received by ASAE members shortly. Non-members interested in attending the meeting should communicate with the central office of the Society at St. Joseph, Mich., for information on accommodations and the program of the meeting sessions.

A general meeting of wide interest, arranged by the Education and Research division, will be held on Tuesday afternoon. A joint meeting of the Power and Machinery Division and the National Committee on Fertilizer Application is planned for Wednesday, December 12.

Complete programs listing speakers for all sessions will be available by November 1. Highlights will be included in the November issue of AGRICULTURAL ENGINEERING.

MEMBERSHIP STATUS

"50 Hundred Members In Our 50th Year"

This slogan was originated by ASAE President Roy Bainer during the 49th Annual Meeting in June

June 1, 1956	4706
July 1, 1956	4727
August 1, 1956	4748
Sept. 1, 1956	4775
Applications being processed	151

Usually complete processing requires about two months after application has been received by ASAE Headquarters

University of Nebraska Dedicates New Concrete Drawbar Testing Course

A new concrete drawbar testing course was dedicated during the Tractor Power and Safety Day, held July 19 at the University of Nebraska, on the College of Agriculture campus. *(Left)* Claude K. Shedd, Life Fellow of ASAE and first test engineer at the Nebraska Testing Laboratory, operates the first tractor model tested, The Waterloo Boy. *(Right)* Victor E. Anderson, Governor of Nebraska, arrives by helicopter. The earthen test course is shown on the outside of the new drawbar testing course

ASAE MEMBERS in the News


F. A. Wirt


A. W. Clyde


W. L. Voegeli


C. E. Hellenberg


E. B. Doran


H. T. Barr

F. A. Wirt (ASAE Fellow and past-president) retired September 15 from J. I. Case Co. after 34 years of service. He joined the company in 1922 as editor of the Case Eagle, a dealer magazine published by the organization, and was later named as advertising manager of the company.

He was born in Omaha, Nebraska, in 1891. He attended the University of Nebraska graduating in 1913 with a B.S. degree in civil engineering, although he specialized in agricultural engineering. After his graduation he was in charge of farm machinery instruction at Kansas State Agricultural College in Manhattan. Later he was employed as sales promotion manager by John Deere Plow Co. at Kansas City, Mo. In 1918 he became extension specialist in farm machinery and head of the agricultural engineering department at the University of Maryland. Then, he served as sales promotion manager for the Emerson-Brantingham Implement Co. at Harrisburg, Pa. Afterwards he was professor of agricultural engineering at the University of Arkansas in Fayetteville until he joined J. I. Case Co.

Mr. Wirt has contributed much to the advancement and use of communication media in agriculture. He has been active in the development of direct mail as a selling method and was one of the first to advocate the use of slides for presenting information about products and farming practices. He was also instrumental in promoting the use of motion pictures, product literature and public relations for advertising.

His interest in the production and distribution of teaching aids has been outstanding, especially in the areas of soil and water conservation and youth programs. Also he has developed documentation of farm machinery from its earliest history to modern-day application.

He joined ASAE in 1916 and served as its president in 1925-26. He became Life Fellow in 1949. He has been active in the Farm Equipment Institute and has been chairman of its advisory council and the soil and water conservation commission. He was a charter member of the Soil Conservation Society of America and has served on its council.

Mr. Wirt has been active in many phases of citizenship and is well known for his lectures and articles.

He and his wife are planning to retire on their farm in South Carolina where he will devote much of his time to a hobby of raising Polled Hereford cattle.

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Arthur W. Clyde, ASAE Fellow, who retired recently after 25 years of service in the department of agricultural engineering at Pennsylvania State University, is now working in the test and development section of implement engineering for International Harvester Co. He is stationed at the company's experimental farm in Hinsdale, Ill. farm in Hinsdale, Ill.

Mr. Clyde joined the Society in 1920 and was awarded the John Deere Gold Medal during the ASAE 49th Annual Meeting at Roanoke, Va., in June.

•

W. L. Voegeli has been promoted from assistant director of engineering to general sales manager, Tractor Group, Allis-Chalmers Manufacturing Co.

He was born on a farm near Wichita, Kans., and started with Allis-Chalmers at the Wichita branch as a serviceman in 1935. After being transferred to the Omaha, Nebr., branch and having spent several months servicing tractors used on the Alcova Dam in Casper, Wyo., he joined the service department staff at the home office in 1936. Later he was promoted to assistant agricultural service manager. In 1946 he was made supervisor of the technical publications department and in 1948 he was appointed agricultural tractor sales manager, a position which he held until he became assistant director of engineering in 1952.

•

Clare E. Hellenberg has been appointed as assistant chief engineer for hydraulic equipment used with farm and materials handling machinery of Vickers, Inc., Detroit, Mich. He is a mechanical engineering graduate from the University of Michigan. In 1941 he joined Vickers as a junior engineer. His experience has included design, development and test operations in connection with a variety of industrial and mobile hydraulic systems. A special engineering group has been set up under his direction which will work toward development of farm and materials handling hydraulic equipment exclusively.

•

E. B. Doran, Life Member of ASAE, who has been head of the agricultural engineering department at Louisiana State University since 1919, retired on June 3, 1956 as "Professor Emeritus."

He received B.S. and M.S. degrees in agricultural engineering from the University of Illinois. He worked for a time with the International Harvester Co. and joined the Louisiana State University staff in 1911.

Over the years he has drawn plans for home economics practice houses, rebuilding of the LSU alumni hall, remodeling of the Pentagon barracks, and laying out the farm buildings for John McNeese College. He is the author of a laboratory manual on terracing, drainage and surveying, and has written several papers on agricultural engineering subjects.

Besides being a Life Member of ASAE, he has served in various offices of the Southwest Section.

•

Harold T. Barr, head of agricultural engineering research, Louisiana Agricultural Experiment Station, has been appointed as head of the agricultural engineering department, Louisiana State University, Baton Rouge. He succeeds E. B. Doran who retired in June, 1956.

Mr. Barr received a B.S. degree in agricultural engineering from the University of Missouri and an M.S. degree from Iowa State College.

After graduation from the University of Missouri he worked in motor building and test work with the Avery Co., Peoria, Ill.

In 1924 he joined the staff in the agricultural engineering dept. of the University of Arkansas. He held this position until he accepted an offer to become affiliated with the agricultural engineering department of Louisiana State University. He became head of agricultural engineering research with the Louisiana Agricultural Experiment Station in 1943.

In addition, he serves as advisor to the editor of *Implementos y Tractores*, the Spanish edition of *Implement and Tractor*, published in Kansas City, Mo., and is engineer-advisor for the Louisiana State Anhydrous Ammonia Commission.

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Peter Hebblethwaite, senior scientific officer, National Institute of Agricultural Engineering, Wrest Park, Bedfordshire, England, is on temporary assignment with the Food and Agricultural Organization in Yugoslavia. He will serve as consultant agricultural engineer in farm machinery testing to advise and assist in setting up a testing department at the Institute of Farm Mechanization at Zemun near Belgrade.

He will be on loan from NIAE to FOA for a total of three months, which will be divided between this visit and another in the Spring of 1957. In exchange a member from the Institute for Farm Mechanization will return with Peter to NIAE to study further testing methods.

Peter joined NIAE in 1949 and shortly afterwards was granted a leave of absence to attend Michigan State University from which he received an M.S. degree in agricultural engineering.

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Charles R. Brandt has left his position of agricultural engineer with the Ministry of Agriculture in Khartoum, Sudan, Africa, to accept employment as an engineer with the Caterpillar Tractor Co. of Peoria, Ill.

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Ralph Hansen, formerly extension agricultural engineer at Iowa State College, Ames, has accepted a position on the teaching staff of the agricultural engineering department at Colorado A & M College, Fort Collins.

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Howard W. Zuch has resigned as cotton ginning specialist for the Texas Extension Service and is taking graduate work at Texas A & M College.

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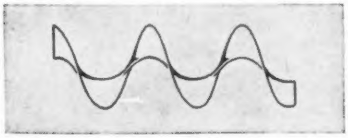

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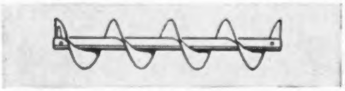

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With the ASAE Sections

North Atlantic Section

The meeting of the North Atlantic Section was held August 28-30 in the new agricultural engineering building, Riley-Robb Hall, at Cornell University, Ithaca, N. Y. The total registration was 195 plus 70 women and 43 children making a grand total of 308 in attendance. In addition to the fine program of papers for the engineers there was an interesting program for the women and children. An outstanding event was a tour to the Corning Glass Works at Corning, N. Y. Also several tours were arranged for both men and women to local points of interest.

On the first evening a chicken barbecue was held in the judging pavilion, with a total of 267 people attending. The banquet, held on the last evening at the Statler Club, was attended by 141 men and women. The banquet was high-lighted by the transfer of official duties to the new section chairman, Herbert N. Stapleton of Shelburne Farms, N. J., and by an illustrated talk on birds by Paul Kellogg of Cornell's Laboratory of Ornithology.

The National ASAE president, Roy Bainer of Davis, Calif., attended the entire meeting. Those who planned the meeting were convinced that it was a successful "trial run" for the 52nd Annual ASAE Meeting to be held at Cornell in 1959.

The North Atlantic Section was organized at Cornell in April 1925. A number of those who attended that meeting were present and several gathered for a group picture, found on this page.

Alabama Section

A meeting of the Alabama Section will be held October 11-12 in the Hotel McDonald at Winfield.

Senator Albert Davis, Aliceville, Ala., will be the speaker at the banquet which is scheduled for the first evening in the Hollis Cafe dining room.

Registration will begin at 11:00 a.m. October 11, and at 2:00 p.m. a tour of the Upper Coastal Plains Substation is planned.

The morning of the second day will be devoted to the presentation of four pertinent papers. Walter Grub, associate agricultural engineer, Alabama Polytechnic Institute, will discuss new innovations in building construction; C. M. Sanders, party leader, Watershed Planning Party, (SCS) USDA, will present a report on small watershed work under Public Law 566; A. W. Cooper, assistant head, Tillage Machinery Laboratory Section, USDA, will present a paper on pressure measurements under tractor and implement tires; and the subject the heat pump—today and tomorrow, will be covered by C. W. Cheatam, heating and air conditioning engineer, Alabama Power Co.

The meeting will close with a business session at 11:10 a.m. Joe Hixon, vice-chairman of the Alabama Section will preside.

Michigan Section

The Michigan Section will hold a meeting October 13 in the agricultural engineering building at Michigan State University, East Lansing. M. L. Esmay, vice-chairman of the Michigan Section, will preside.

Registration will begin at 9:00 a.m. and A. W. Farrall, head, agricultural engineering department, MSU, will give the introductory speech at 9:45 a.m. The program committee reports that an outstanding program has been planned which includes discussions on research techniques of the atomic age and the engineering aspects related to the "cold" sterilization of farm products. The subjects covered will be on plant nutrient radio active tracers by K. Lawton, soil science dept., MSU; radiological tracers, application and instrumentation by W. K. Dorn, Tracerlab, Inc., Boston, Mass., and irradiation of farm products and the engineering involved, by L. E. Brownell, Fission Products Laboratory, University of Michigan. R. J. Alpers, chairman, will conclude the morning session with announcements.

A social hour and a short program on the techniques of block printing and other subjects of interest will be held for the ladies during the morning.

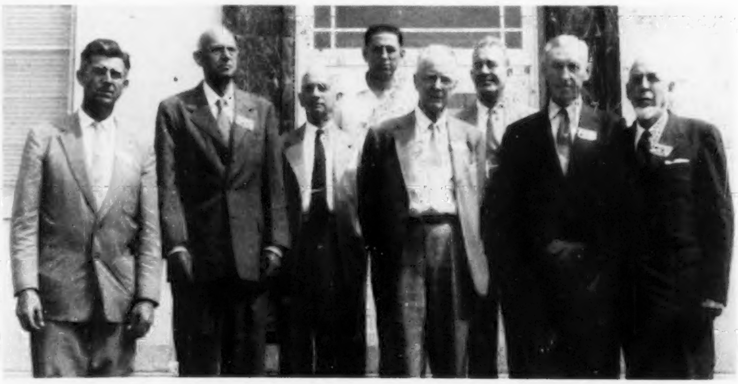
At 2:00 p.m. a football game will be played between Michigan State University and Indiana University, and those wishing to, may attend.

Pennsylvania Section

A meeting of the Pennsylvania Section will be held at the Beachcomber Hotel, Erie, Pa., October 18-19. Registration will begin at 1:00 on the first day. Introduction of guests will be made by Walter Gross, Pennsylvania Power Co., who will preside at the meeting. Papers on potato harvesting and storage, by Howard D. Bartlett, Pennsylvania State University; frost control with irrigation, by Harold E. Brannaka, New-Way Farm Sales; marketing problems in Northwest Pennsylvania, by H. L. Moore, Pennsylvania State University; the heat pump in Pennsylvania, by Robert S. Crist, West Penn Power Co., and ethics of engineering, by Ralph E. Patterson, Pennsylvania State University.

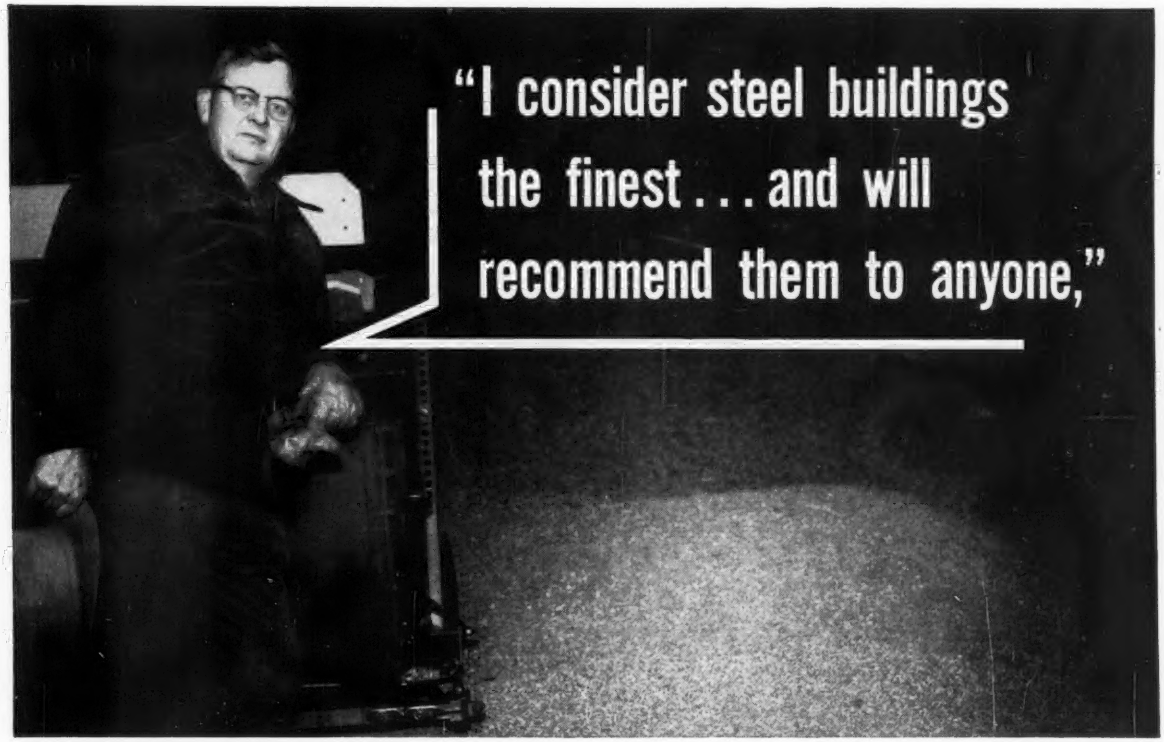
An informal dinner is planned for Thursday evening at 6:00 p.m. with general group discussions immediately following the meal. The discussion on rural electrification will

(Continued on page 692)



(Above) Old Timers in the North Atlantic Section of ASAE. All except Orval French and National ASAE President Roy Bainer were present at the organization meeting of the Section at Cornell in April, 1925. *(Left to right)* Orval French, W. C. Harrington, J. C. McCurdy, M. S. Klinck, Ray Carpenter, Roy Bainer, L. G. Heimpel and H. W. Riley

(Left) The executive members and committee chairmen of the Pacific Northwest Section of ASAE met recently in Penticton, British Columbia, to plan for the section meeting, Oct. 24-26. *(Left to right)* T. L. Coulthard, section chairman; R. W. Okey, P. R. Bakes, R. S. Tait, H. E. Wichers, M. J. Morgan, and J. C. Wilcox. Penticton is a fruit growing center, and J. C. Wilcox is showing souvenir miniature apple boxes to the group



...says Howard Henry, Westhope, North Dakota

Mr. Henry has a 36′ x 100′ galvanized steel building on his farm, in which he stores 16,000 bushels of wheat and two self-propelled combines. He likes his steel building so well that he plans to erect a 30-foot addition to it in the near future.

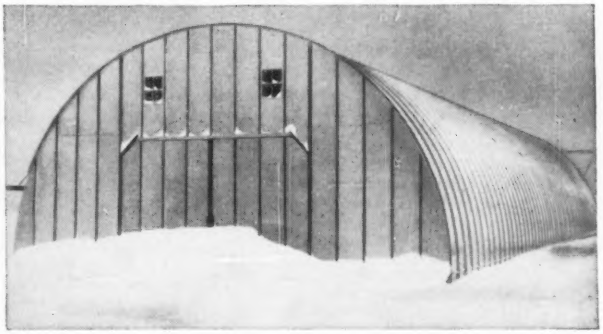
Farm buildings using USS Galvanized Steel Sheets have two basic advantages over other types of farm buildings. First, steel is much stronger and more rigid than any other construction material. The Galvanized Steel Sheets won't buckle or rip loose around fastening heads in strong winds, nor will they sag under heavy snow loads. Secondly, Galvanized Steel Sheets are much more fire resistant and have a much higher melting point than other farm building materials. Fire underwriters consider steel construction to be the safest of all. Moreover, steel buildings are easily grounded against lightning.

Buildings manufactured from USS Structural Steel and roofed and sided with USS Galvanized Steel Sheets offer the additional advantages of quick, easy erection, low maintenance cost, and top protection against wind, rain, and rodents. And, the roomy, clear-span steel buildings are versatile—ideal for every use from grain storage to poultry housing.

It will pay you to investigate Factory-Built Steel Farm Buildings, manufactured with long-lasting USS Galvanized Steel Sheets for roofs and walls, and a USS Structural Steel framework.

6-90B

UNITED STATES STEEL



For your assurance of a high quality Factory-Built Farm building ask for USS Galvanized Steel Sheets for roof and sides. These sheets have a zinc coating produced to ASTM Specification A-361.

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Agricultural Extension, United States Steel Corporation
Room 4/ 525 William Penn Place
Pittsburgh 30, Pa.

I am interested in steel buildings for the following:

☐ machinery storage ☐ grain storage ☐ cattle shelters
☐ hay storage ☐ dairy barns ☐ poultry houses
☐ other ....
Approximate size or capacity ....
☐ Please have a Steel Building representative call on me with further information.

Send information to:

Name ....

Address .... Town ....

County .... State ....

United States Steel Corporation produces high-quality USS Galvanized Sheets and Structural Steel which our customers manufacture into durable farm buildings. Your requests for information will be forwarded to the manufacturers of these buildings, and you will hear directly from them.

With the ASAE Sections

(Continued from page 690)

be led by William C. Wenner, Northwestern Rural Electrical Co-op; power and machinery, by E. A. Silver; New Holland Machine Co.; farm structures by Harold Walton, Pennsylvania State University; and soil and water by Gil Oesterling, Soil Conservation Service, USDA.

Friday morning at 8:00 a.m. a tour of the Peninsula has been arranged. The morning session will begin at 9:00 a.m. with Ralph E. Patterson, Pennsylvania State University presiding. The theme for the meeting will be on grassland farming. Local farmers will attend the meeting and give short talks on experiences with grassland farming. Other pertinent topics to be presented will be on new research in hay drying, by William L. Kjelgaard; latest trends in wagon drying, by Joseph A. McCurdy; preventative maintenance of silos, by Harold Walton; and trends in forage harvesting equipment, by C. B. Richey. A business meeting will be held at the close of the morning session.

Friday afternoon those who like to fish may enjoy a time of fishing on Lake Erie. Tours have also been scheduled to Welch's grape juice plant and to a modern dairy farm.

Virginia Section

The Virginia Section meeting will be held at Hotel Jefferson in Richmond on October 19 and 20. Registration will begin at 12:00 p.m. October 19. V. H. Baker, section vice-chairman, will preside during the Friday afternoon session. K. M. Bannie, International Harvester Co., Chicago, will speak about new developments in forage harvesting and handling. General H. B. Holmes, State of Virginia, Division of Planning and Development, will talk on the intent and interpretation of the Virginia Water Law; and J. T. Cutchin will discuss uses of electric heat in agriculture. A report from V.P.I. ASAE student branch, and a talk on the factors that influence boys to study agricultural engineering, by E. T. Swink will follow. J. L. Butt, ASAE secretary, will speak about agricultural engineering trends.

M. A. Hubbard, executive secretary, Virginia Farm Bureau Federation, will be featured speaker during an evening session following a banquet.

G. W. Halsey, section vice-chairman, will preside during the Saturday morning session. J. H. Lillard, leader, agricultural engineering research, V.P.I., will review agricultural engineering research in Virginia. Projects include poultry house ventilation by McNeil Marshall; structural stability of farm buildings by H. T. Hurst; drainage by J. P. Walker; agricultural hydrology by J. B. Burford; insects by J. M. Stanley; tobacco by V. H. Baker; peanut curing by N. C. Teter; and peanut harvesting machinery by G. B. Duke.

The meeting will adjourn in time for the V.P.I.—University of Richmond football game, October 20.

Pacific Northwest Section

The meeting of the Pacific Northwest Section will be held at the Prince Charles Hotel, Penticton, British Columbia, October 24 to 26.

Registration will begin at 6:00 p.m., October 24. At 7:30 Mayor Oscar Mattson will extend a welcome. J. S. Allin, B. C. Department of Agriculture, will speak on agriculture in British Columbia. A panel group, E. L. Barger, W. H. Knight, C. A. Oliver, and Paul Slusser, led by Roy Bainer, National ASAE president, will discuss the question—why agricultural engineering?

Thursday morning will begin with a general session. Introductory remarks will be made by Section Chairman T. L. Coulthard, followed by a message from ASAE President Roy Bainer. Erwin R. Baker, Sylvania Electric Products Co., will speak on increased convenience, production and safety on the farm through better lighting, and LaSalle Coles, vice-president, National Reclamation Assn., will discuss a basis for the total development of waters in the Northwest.

At 10:30 two concurrent sessions will begin. The first paper on the program of the joint session of the soil and water group with the power and machinery group will be presented by Dan Evans, and will be on the subject of compaction on irrigated pole beans. Dale Kirk will follow with the subject of straightening aluminum tubing with hydraulic pressure. The closing two papers will discuss the relative capacity of various classes of tillage tools to bury surface trash cover, by D. T. Anderson, and soil compaction in irrigated soils, by Roy Bainer.

A discussion about the application of water-to-air heat pumps for house heating in rural areas, by Roland E. Pillat, will open the joint session of the rural electric group and farm structures group. Paul Slusser will present farm electrification problems and needs, and F. G. Crofton will discuss plywood structures.

The afternoon meeting will start with a general session during which W. H. Johnson will speak on new trends in harvesting machinery and J. L. Thompson will discuss Canadian farm building planning service.

Topics covered in joint sessions following the general session, include implement industry's contribution to materials handling; beef corrals; new West Coast lumber grade; water for thirsty acres in the Lillooet area; and a study of electrical use in sprinkler irrigation.

A student banquet will be held at 6:00 p.m., October 25. Robert Morgan will preside. Students and faculty advisors shall attend through courtesy of R. M. Wade and Co., Portland, Ore.

Four concurrent programs will be held Thursday evening. A committee business meeting and election of officers will follow. Papers include subjects on European balers; equipment and labor for harvesting hay crops; semi-self-propelled harvesting machines; arch-rafter construction; electrical problems impeding the progress of automation in agriculture; a report on the rural electrification program held at Roanoke, Va.; pan evaporation as a measure of consumption use; plot sprinkler for small irrigated plots; and simulating mechanically the infiltration of water into soil for laboratory irrigation investigation.

The final day, Friday, October 26, will be devoted to a general session during which a paper on the professional engineer; reports of ASAE student branch activities; and student papers and awards will be presented. A business meeting, committee report and election of officers will close the morning session.

At 1:30 the four divisions of ASAE will journey to the Dominion Experimental Farm at Summerland. Concurrent programs have been scheduled, and papers to be presented will cover subjects on fertilizer application, irrigation of alfalfa, sweet corn production, soil moisture, and air-blast concentrate sprayers.

The session will close with a tour of the experimental station.

Ohio Section

A meeting of the Ohio Section will be held October 26-27 at the Ohio State University, Columbus. Registration will begin at 1:00 p.m., Friday, October 26, and the first session will begin at 1:30 p.m. at The Ohio Union.

The theme of the meeting will be Shelled Corn Harvesting and Storage as it relates to on-the-farm applications. Papers will be presented on the subjects, comparison of corn harvesting methods and equipment; principles of drying; heated air-batch or continuous drying; use of supplemental heat in drying-in-storage; storage for shelled corn; and economics of drying and storage of shelled corn on the farm.

On Friday afternoon a panel discussion will be held on the opportunities in agricultural engineering for engineering students. Panelists will represent each of the major fields of agricultural engineering. A banquet is planned for Friday evening. The meeting will conclude with the group attending the Ohio State - Wisconsin football game Saturday afternoon.

Oklahoma Section

A meeting of the Oklahoma Section will be held Friday, November 30th, at the Student Union building on the campus at Oklahoma A & M College in Stillwater. Arrangements have been made to hold this meeting in Room B2 in the basement of the Student Union building in the south end. Chairman Fred Gray will open the session at 9:50 in the morning.

Extensive efforts are being made to arrange a program that will be of interest to all members of the Society. Speakers are being secured to discuss such timely topics as: new rural developments in summer and winter air conditioning; water laws in Oklahoma; timely irrigation discussion, including development of irrigation wells; a demonstration of the characteristics of centrifugal pumps, and the use of polyethylene in sealing farm ponds.

NECROLOGY

L. H. Smith, Lafayette, Ala., was killed in an airplane crash, June 23.

A native of Alabama he was born in 1897 in Chambers County. He received his education from Georgia Institute of Technology, majoring in electrical engineering.

He owned and operated a farm near Lafayette and was a dealer for Farm and Implement Sales in Opelika, Ala. Mr. Smith was a member of the National Flying Farmers Association and had served as a director. He also was a past-president of the Alabama Flying Farmers Assn., and assistant regional director.

•

Reed M. Syler, assistant sales manager, Agricultural and Industrial Div., Motor Wheel Corp., was killed in an automobile accident August 1.

He was born in 1920 at Racine, Wisconsin. In 1941 he graduated from the University of Wisconsin with a B.S. degree in chemistry. After his graduation he was employed by the U.S. Rubber Co., Detroit, Mich., and later became district manager of sales in the Chicago office. In 1950 he accepted the position with Motor Wheel Corporation which he held at the time of his death. He resided in Maywood, Ill.

70-hp Air-Cooled Engine

Lycoming Division, Avco Mfg. Corp., 550 S. Main St., Stratford, Conn., has introduced a new valve-in-head, air-cooled, 4-cylinder V-type engine designed for all general applications in the industrial, agricultural and construction fields. Designated as the model CV4-180, the engine is said to deliver 70 hp at 3000 rpm.

The new engine features interchangeability of major component parts with its counterpart, the C2-90 model 30-hp engine, such as the aluminum cylinder head of valve-in-head design, cylinder barrels, pistons, forged connecting rods, bearings, valves, etc. A full-pressure lubricating system is employed.

A four throw, three main bearing dynam-

ically counterbalanced crankshaft and twin three bearing camshafts are included in the engine design. All engine accessories are flange mounted and gear driven from the timing gear train housing. The new engine weighs approximately 463 lb without electric starter, generator and flywheel housing which are being offered as optional equipment. The engine power end will be offered with SAE No. 3, 4, and 5 bell housings as with special pump adaptors and shaft extensions to suit customer requirements.

The engine has a 4-in stroke, 3½-in bore and 176-cu in displacement. It is 28 in long, 27.68 in wide and 28.57 in high, without air cleaner.

Unveils Experimental Model Air-Conditioned Tractor

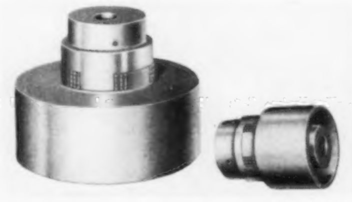
J. F. Schaffhausen, operational director of Cockshutt Farm Equipment, Inc., Bellevue, Ohio, at his Bucks County, Pa. experimental farm unveiled an experimental model of an air-conditioned tractor.

Reduced fatigue, increased operator efficiency and higher crop yields are listed among advantages of the new design. The cab is also equipped for winter heating and features a built-in, push-button radio. It is reported that a production model will be planned when market demand is evident.

NEW PRODUCTS CATALOGS

Flexible Coupling Features Brake Drum Flange

Lovejoy Flexible Coupling Co., Dept. AES, 4801 W. Lake St., Chicago 44, Ill., has developed a new coupling which incorporates a brake drum flange on the outer diameter. This feature is said to provide a compact drive arrangement and is particularly useful where shaft length or distance



between two units is at a premium. It is said that the brake drum entails no more space than that required by the flexible coupling.

The new brake drum coupling is available in 8 standard sizes, with ratings from 2 to 40 hp at 1750 rpm. Maximum bores of the hub body range from 1 to 2½-in. Drum body bores are made to motor shaft size specifications. Distance between shafts runs from ½ to 1⅞-in. Cushions are one-piece spider type.

New Shop Dynamometer

M & W Tractor Products, 5021 Green St., Anchor, Ill., has announced a new type shop dynamometer. This new testing device, called the Hydra-Gauge dynamometer, permits a mechanic to diagnose carburetion and ignition troubles instantly. Single dial horsepower readings let mechanics and the customer see the difference in tractor performance.

The new dynamometer permits tractors to be tested under actual field load conditions, in the service shop. The unit is portable and a single operator can connect the machine to a tractor PTO and develop any number of pulling conditions that are experienced in farm work. Carburetor and ignition changes can be made under actual load conditions.

Complete details concerning the new device and a free demonstration may be obtained by writing to the company.

Trip-Shank Field Cultivator

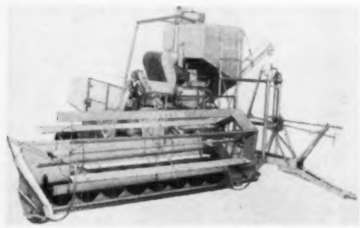
Tractor and Implement Div., Ford Motor Co., Birmingham, Mich., has introduced a new heavy-duty field cultivator that is equipped with spring-loaded trip shanks. Each shank has an individual spring-loaded trip mechanism which holds it in a fixed position, but permits the shank to swing back and upward when an obstruction or overload is encountered. Raising the implement momentarily automatically resets the shanks. This new trip shank design is said

to maintain a constant pitch setting on sweeps and shovels regardless of changes in draft.

The new cultivator is available in fully tractor-mounted 7 and 9 shank models for both Ford and Fordson Major Diesel tractors. It uses three banks of shanks, has ample trash clearance between shanks, and is available with a wide selection of sweeps. Gage wheels are available as optional equipment for use with tractors which do not have implement depth control. The trip mechanism can be set for release at 1500 lb for normal operation or 2500 lb for heavy work. When deeper penetration is desired, the number of shanks can be reduced.

New 12-Ft Combine

Minneapolis-Moline Co., Minneapolis 1, Minn., has announced a new pull-type grain, seed, and bean harvester with a 12-ft cutting swath. The new Model G-144, successor to the Model G-4, features a new 4-cylinder, Model 206-J4 engine to power the threshing mechanism. A 17-gal fuel tank is located low for refueling without climbing. The engine is equipped with an electric



fuel pump, weather cap and a new instrument panel for easy engine readings.

Other features of the harvester include a rock-trap concave with single-lever adjustment and graduated scale for quick concave settings; heavy-duty, 31¼-in rasp-bar cylinder with double-roller chain drive; a 3,520 sq-in separating surface; 5-way adjustable cleaning shoe; and optional manual or hydraulic header control.

The hydraulic unit can be powered from the tractor or from the auxillary engine, and can be operated from either the tractor seat or the operator's platform on the harvester.

(Continued on page 696)


HOW TDA®
HELPED PUT MORE "DRIVE" INTO POWER FARMING!
This newest of self-propelled combines represents another great forward step in power farming—thanks to the teamwork of one of America's largest manufacturers of farm equipment and Timken-Detroit® Axle.
Completely new from top to bottom, this 10-foot combine offers new convenience, easy control—and a totally new, specially-designed TDA driving assembly that permits changing ground speed on-the-go without touching the throttle, or affecting the separator speed.
Field proved under many conditions in South America, Mexico, and here—this new combine will harvest all grains—soy beans, alfalfa, wheat, and corn, the latter with a special header unit.
Once again, Timken-Detroit experience, research and engineering ability have helped another farm equipment manufacturer solve another design problem . . . build a better product. If you have a problem in designing or building driving assemblies for farm equipment, call in Timken® engineers. It costs you nothing—and will save you money in the long run.
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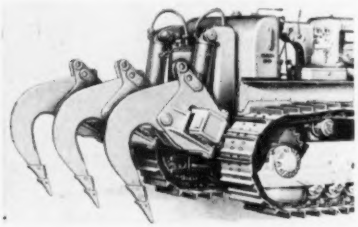
New Products and Catalogs

(Continued from page 694)

Tractor-Mounted Ripper

Caterpillar Tractor Co., Peoria, Ill., has announced a new tractor-mounted ripper designed specifically for use with the D9 tractor. The ripper consists of two mounting brackets, two hydraulic cylinders, one beam assembly, and three teeth. It weighs 10,830 lb and mounts on the bevel gear case through a special drawbar bracket group which replaces the standard drawbar brackets. Ripping depth is down to 28 in.



The box-section beam is made of alloy steel plates, submerged arc welded, and reinforced inside by additional plates. The shanks are made of heat-treated steel with a hardened alloy cast steel boot which has a replaceable, hardened cast steel point. The teeth are swivel mounted. When rocks or other obstructions are encountered, the teeth will swivel up to 10 deg.

The ripper is used primarily to break up hard materials for subsequent scraper loading. When mounted on a tractor used for push loading, it can rip between cycles. Other jobs include breaking up old blacktop or concrete, clearing and ripping roots, and breaking frozen ground or stratified shale.

One-Piece Mesh Crib

The Pennington Mfg. Co., Addison, Ill., has introduced a prefabricated one-piece mesh crib. The horizontal bars of the mesh are 2-in apart and all models feature side walls in one continuous roll of wire for easy handling. Angle iron vertical stiffeners are bolted to the walls without cutting the

roll into panels and floor anchors are furnished for every vertical support.

All sections of the steel roof are ribbed at each joint and peaked to a removable center cap. A ladder section of the roof is furnished complete with rafter supports. The entire roof assembly is bolted to the crib at every joint with a specially designed bolt.

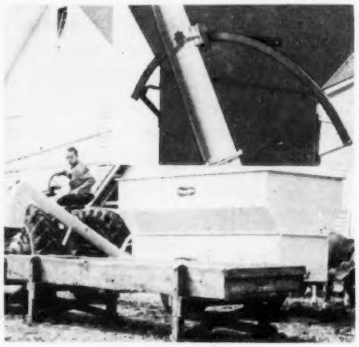
Rust Preventive Booklet

The Flood Company, Hudson, Ohio, has published an attractive new 8-page booklet describing Penetrol, a rust preventive, paint extender, and reinforcing paint additive. Profusely illustrated and containing a text which can be readily understood by laymen, painters, and paint chemists alike, the booklet should find wide interest and circulation throughout the general industrial, agricultural, automotive, marine and other fields. Measuring 8½ x 11 in, it is designed for easy permanent retention in the office filing system. Requests for copies should be addressed direct to the company.

Auger Wagon Features Elevator Position Clamp

Knoedler Manufacturers, Streator, Ill., has announced a new auger wagon that features a wheel-spin friction clamp for speeding positioning of the angle of the elevator, as well as the direction of grain flow. The clamp replaces the chain adjustment and travels on a semi-circular arm (inset).

The elevator can be rotated at its base allowing for quick control of the discharge



spout. Weight of moving grain or vibration does not alter the elevator angle, or direction of discharge, once the clamp is tightened.

Available in 6-ft lengths with a capacity of 80 bu (101 bu with extensions), and in 8-ft lengths, 107 bu (135 bu with extensions), this new auger wagon is said to put out up to 50 bu of grain a minute. The elevator can be installed either front or rear as ordered.

Tree Power Cultivator

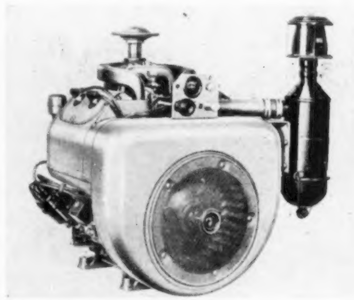
Roper Mfg. Co., Zanesville, Ohio, has announced a new tree power cultivator for control of mice and mole damage, and

mulching around fruit, nut and ornamental shade trees. The new tool is designed for installation on 2 or 3-point tractor hitches. It can be used either with 32-in spike roller or easily attached 10-in extension to provide 42-in length.

New V-4 Air-Cooled Engine

Wisconsin Motor Corp., Milwaukee, Wis., has announced production of Model VH4, a new 30-hp, 4-cylinder, V-type, air-cooled engine designed to meet requirements between the company's 25-hp and 36-hp models. The new engine operates at a maximum speed of 2800 rpm and can be adapted to operate on kerosene, natural gas, LP-fuels or fuel oil of 38-42 deg Baume gravity and 35 octane rating.

Special equipment includes hydraulic



pump, visual-type air precleaner, rotating screen, automatic high temperature switch, electric generator and starter (or starter only), clutch assembly, reduction assembly or clutch-reduction assembly. The engine can be supplied as an open engine with or without side-mount fuel tank or as a completely housed power unit with either built-in or underslung fuel tank. Specification literature (Bulletin S-196) is available by writing to the manufacturer.

Farm Buildings Catalog

Stran-Steel Corp., Ecorse, Detroit 29, Mich., announces an illustrated catalog giving details of recent improvements and developments in the Quonset line of steel buildings for farm use. Included in the catalog are the farm service and repair center and machinery storage buildings, the grain-drying and storage systems, and bowstring-truss grain storage structures.

The farm service and repair center and machinery storage buildings were developed to help the farmer protect his equipment. The catalog presents illustrations of the structures in use. A breakdown of space requirements for farm machinery is provided as well as suggested layouts for the service and repair centers.

The grain drying and storage system consists of a Quonset grain storage building, an air-distribution system and fans to force the air through the unheated grain. After the grain is dried the fans are reversible for cooling. Increased capacity bowstring-truss grain storage buildings are now available in widths of 50 and 60 ft and eave-heights of 15 and 20 ft.

A table of space-requirements for beef and dairy cattle, hogs, sheep and poultry is provided. A central portion of the catalog is devoted to illustrated descriptions of the up-to-date features and accessories of the Quonset and rigid frame farm buildings. Hay-drying, storage and self-feeding systems are displayed in another section of the catalog. These buildings are available in 32 and 40-ft widths. The catalog lists tonnage capacities of the structures for long, chopped and field-baled hay. Manger-space and feed requirements are also tabled. The final section of the large brochure describes some of the specialized farm uses of these buildings. The catalogs are available upon request from the company.

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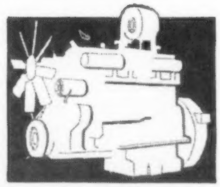
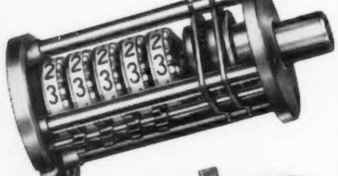


For every engine, there's a VEEDER-ROOT REV-COUNTER to prove your product's claims

Rev-Counter for general built-in use. Self-contained case is designed for outside application.

Rev-Counter especially designed for installation in user's housing.



Rev-Counter especially designed for built-in installations.

That's right . . . you can build into your engine a real "performance-prover" that keeps a faithful and complete record of engine use . . . a record that's beyond dispute. These Veeder-Root Rev-Counters *show you and your customers*, at any time, exactly how your equipment is performing up to its guarantee . . . whether they're getting out of it all the service you built into it. These direct counter-readings also show at a glance when routine maintenance is coming due . . . whether servicing is needed . . . and supplies other valuable facts-in-figures.

This 2-way protection is vital not only as a built-in feature of engines, but also of generators, compressors, heaters, refrigerators, high-speed cameras, and what have *you?*

Veeder-Root Rev-Counters are available with *tachometer take-off* . . . and may be geared to your own engine requirements. Count on Veeder-Root for any assistance you need in designing these Rev-Counters into your product. Write:

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Everyone Can Count on

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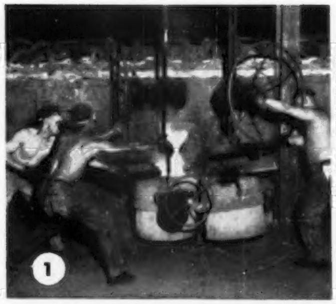
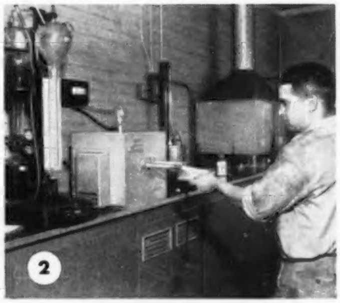
"The Name that Counts"

STOCKS OF STANDARD COUNTERS AVAILABLE AT
Greenville, S. C. • Chicago 6, Ill. • New York 19, N. Y. • Los Angeles • San Francisco • Montreal 2, Canada • Offices and Agents in Other Principal Cities





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2. Metal entering and leaving plant receives chemical analysis to insure quality.

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4. Latest Brinell Hardness Tester is another of Peoria Malleable's testing equipment that assures top-notch casting.

5. Even mold sand is tested to make sure castings receive the best possible finish.

A big part of **QUALITY** is a **QUALITY** part

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PEORIA MALLEABLE CASTINGS CO.

Ft. of Alexander St., Peoria, Illinois

famous for **QUALITY**

AD 450

New Products and Catalogs

(Continued from page 696)

Aluminum Nail and Fastener Distribution Expanded

Aluminum Company of America, 784 Alcoa Bldg., Pittsburgh 19, Pa., has announced plans to make available its line of aluminum nails and fasteners to the general public. The product line previously was supplied principally to industrial users.

Alcoa nails will be contained in a bright red, white, blue, and black easy-open package. A wrap-around label shows the actual size of the enclosed nail, gives a count of the content, and describes the type of nail and its use.

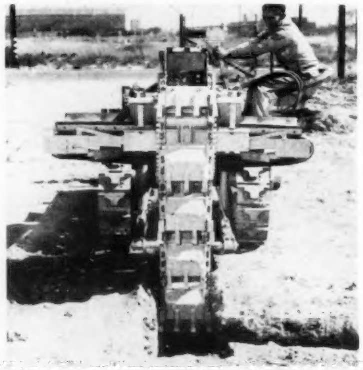
Radial Roller Bearing Catalog

Rollway Bearing Co., Inc., 541 Seymour St., Syracuse, N. Y., has published a new 56-page catalog-manual, entitled Precision Radial Roller Bearings, which contains tabular information on radial static and dynamic capacities and thrust capacities computed for the company's line of radial roller bearings.

Application data covers load ratings, radial internal clearances, temperature allowances, provision for float, alignments, seals and lubrication. Tables list limits for shaft diameters and housing bores to obtain proper fit of inner and outer races under various operating conditions. An alignment chart for making calculations and bearing selections is included.

Purchases Trencher Rights

Challenge Mfg. Co., 7400 E. Bandini Blvd., Los Angeles 22, Calif., announces the purchase of the Heller Mfg. Corp., and



production rights of the Universal trencher. The manufacturer states that the trencher is designed solely for utility trenching. It is hydraulically controlled, has a side seat arrangement and it trenches up to a 4-ft depth and 14, 16 and 18-in widths. It has eight digging speeds, safety clutch and hydraulically controlled backfiller blade. It digs square corner trenches and cross trenches. Dirt can be switched from side to side without stopping.

Models are available for mounting on Oliver OC-3, and John Deere 40-C and 420-C tractors.

Washer Catalog

Wrought Washer Mfg. Co., 2100 S. Bay St., Milwaukee 1, Wis., has issued a new catalog, No. 40, which describes and lists by sizes the company's line of washers, bushings and expansion plugs.

Among several new features incorporated in the catalog is a new format for U.S. Standard, SAE and machinery bushings lists, laid out in conformance to National Industrial Distributors standards for jobber catalogs. A handy alphabetical index covers 75 different catagories and included also are reference tables for standard wire gauges; circumferences and areas of circles; threads, bolts and nuts and a new decimal equivalent chart which is detachable for reference.

Requests for the new catalog should be addressed to the company.

Announces New Loader

International Harvester Co., Chicago 1, Ill., has introduced the new McCormick

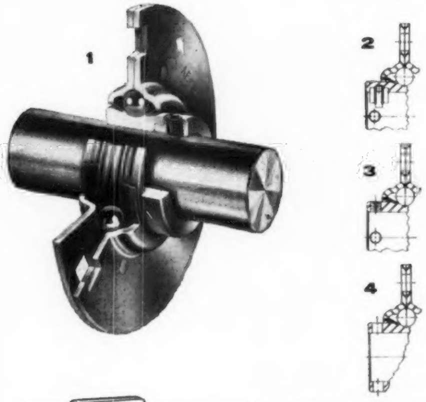
34HM-33 loader for mounting on wide-front axle as well as tricycle-type Farmall tractors of the 300, 400, Super H, and Super M series. The manure fork with tine-cover is interchangeable with a 9-ft material bucket. Both bucket and fork are controlled by a mechanical trip.

(Continued on page 708)

Aetna

SEALED, PRE-LUBRICATED BALL BEARING package UNITS

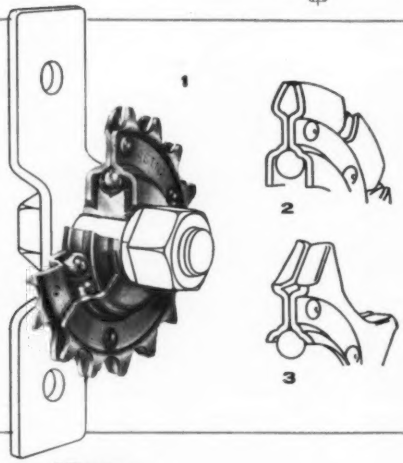
Easy To Apply . . . Require No Maintenance . . . Inexpensive



ADAPTER UNIT

Designed for light-duty moderate-speed applications, this multi-purpose economy-priced unit mounts easily, quickly, wherever shafts can be supported—on sheet metal or any semi-rigid structural members. Sealed, pre-lubricated bearing is self-aligning; takes radial, thrust or combined loads. Available in 4 shaft-locking types, (1) with eccentric locking collar,* (2) with ball lock,‡ (3) with two set screws,‡ (4) drilled for roll-pins.‡

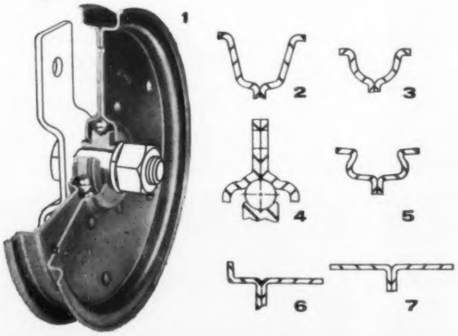
*Standard ‡On special order



SPROCKET IDLER UNIT

A sprocket idler and pre-lubricated, sealed, ball bearing —*all-in-one*. Bearing has triple-capacity lubricant chamber, full complement of balls for greater load capacity, 4-point ball contact for greater rigidity, case-hardened inner and outer races. Bore sized for ⅝" or ½"* mounting bolts—available with sprockets (as illustrated) to fit (1) standard pitch, (2) extended pitch roller chain or (3) detachable link chain.

*On special order



BELT IDLER UNIT

Designed and built-to-be-installed-ana-forgotten this permanently lubricated, sealed-for-life idler unit requires no re-lubrication, no maintenance of any kind. I. combines bearing, seals, and pulley in a single, compact, easy-to-install *package* assembly. Bore sized for ⅝" or ½"* mounting bolts. Sheaves (available in 7 types illustrated) and bearing outer race are of heavy-gauge, case-hardened steel.

*On special order

GET THE FACTS . . .

See how these low-cost units can be adapted to either your current or projected equipment designs with minimum, or no, engineering alterations. Write us or call in our local expert, your nearby Aetna distributor.

Aetna

40 YEARS

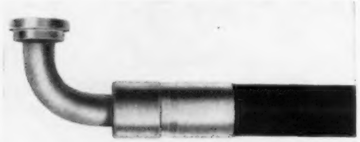
AETNA BALL AND ROLLER BEARING COMPANY
Division of Parkersburg-Aetna Corporation
4600 Schubert Ave., Chicago 39, Illinois

New Products and Catalogs

(Continued from page 706)

Split-Flange Coupling

Anchor Coupling Co., Inc., 342 N. 4th St., Libertyville, Ill., has announced a new 4-bolt, split-flange, pressed-on coupling with a 360-deg swivel joint for convenience in positioning and installing. This new swivel, combined with the no-thread, no-leak features of the coupling O-ring seal design gives the engineer new design freedom and prevents danger of hose twisting. The new coupling is available in all sizes from ½ through 1½ in and in all standard bends from 0 to 90 deg. The manufacturer reports that thinner sections on valve and pump bosses are made possible and the hose assembly can be connected and disconnected time after time without danger of leaks.



Tillage Equipment Booklet

Rome Plow Co., Cedartown, Ga., has published a new booklet describing the complete line of the company's equipment. Methods and equipment for clearing, developing and improving land, for big scale seedbed preparation and for deep tillage are discussed.

Booklets are available in English, Spanish, Portuguese and French, and can be obtained by writing direct to the company.

New 2-Way Disk Plows

Rome Plow Co. of Cedartown, Ga., has developed two new 2-way disk plows designed for deep plowing with 15-in penetration. Both new disk plows are of similar design. The PA 3-28, as the smaller plow is designated, is a 3-blade plow that takes a 33-in width of cut and has three 28-in disk blades (30-in blades optional). The larger plow, the PA 4-28, takes a 44-in width of

cut and has four 28-in blades (30-in blades optional). To lessen the draft in exceptionally tough or deep plowing, a disk and standard can be removed. For operation the tractor requires a hydraulic pump and double valve control.

One hydraulic control lever raises the plow from the ground and another control lever actuates the hydraulic ram that swings the disk plow beam into position to cast dirt in the opposite direction. Penetration is regulated by adjusting the stops on the hydraulic rams. A new knife-type land slide is used to hold the blades in line. The land slide is hard-faced and can be sharpened or replaced in a farm workshop.

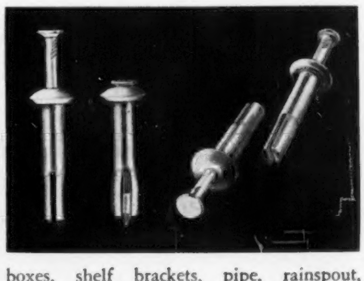
Direct-Drive Generating Plants Added to Line

The Wincharger Corp., Sioux City, Iowa, has announced that two new direct-drive generating plants have been added to the Winco line of engine-generators.

The new units, both designed to run at 1800 rpm, supplement the manufacturer's line that includes both 3600 rpm direct-coupled and belt-connected models. The Series 2B23S4D is rated at 2000 watts, with intermittent overload capacity. The 102B-14S4D is rated at 1250 watts, likewise with margin for temporary overload. Both units are available with either manual or remote start, and they can be supplied with a 2-wheeled dolly or with a carrying cradle. Also, in both series, the generator is driven by a Briggs & Stratton engine.

Masonry Expansion Drive Rivet

Southco Division, South Chester Corp., Lester, Pa., has developed a new masonry drive rivet for fastening electrical conduit,



boxes, shelf brackets, pipe, rainspout, aerials, hinges, signs, and similar items to all kinds of masonry — brick, stone, concrete, or composition cinder block.

Installation is accomplished by drilling a ¼-in hole, insert the rivet, and hit the nail-like pin with a hammer. The end of the rivet expands holding it deep in masonry.

NEW BULLETINS

Nail Popping, Its Causes and Prevention, by E. George Stern. Virginia Polytechnic Institute Wood Research Laboratory (Blacksburg) Bulletin 24 (May, 1956). The 12-page bulletin is divided into three parts. The first part covers causes of nail popping, the second part covers prevention, and the third part reports laboratory data on nail popping. The data contained are derived from the U. S. Forest Products Laboratory, Agricultural Experiment Station of Purdue University, and the VPI Wood Research Laboratory.

Harvesting and Storing Silage, by J. L. Butt. Agricultural Experiment Station of the Alabama Polytechnic Institute (Auburn) Circular 117 (June, 1956). The 14-page bulletin covers three years of tests on silage harvesting methods at five locations in Alabama. Harvesting methods include direct-cut using forage harvester; direct-cut using row-crop forage harvester; baled silage using hay baler; buckrake method, and hay-loader method. Each method was studied in terms of capacity, labor, equipment requirements, and costs. Tests were conducted in a variety of silage crops and over a wide range of terrain and field conditions. Observed advantages and disadvantages are listed for each method tested.

Improved Spray Boom for Row Crops, by G. J. Burkhardt and L. P. Ditman. Maryland Agricultural Experiment Station (College Park) Miscellaneous Publication No. 269 (July, 1956).

This 8-page bulletin covers the design and fabrication of a means for mounting spray nozzles at a given height above the ground regardless of ground contour. Plans for constructing a 4-row spray boom are included. With a few adaptations the boom reportedly can be mounted on most tricycle-type tractors.

Copies of the bulletin are available by writing to the Agricultural Engineering Dept., University of Maryland.

Handling Fertilizer in Bulk, by Vernon Sorenson and Carl Hall. Michigan Agricultural Experiment Station (East Lansing) Bulletin 408 (June, 1956).

The 20-page bulletin reports on a study of the cost involved in handling fertilizer in bulk from the manufacturing plant to the farm. Data are presented which can be used to estimate the cost of delivering bulk fertilizer in various quantities and to various distances. Copies may be obtained by writing to the Bulletin Room, Michigan State University.

Multicombination Pole-Type Construction, by Leroy Bonnicksen. Oregon Agricultural Experiment Station (Corvallis) Bulletin 557 (July, 1956).

This 23-page publication offers a different concept of presenting farm-building plans. From the illustrations of the basic details of the pole-type construction described, plans can be developed for many combinations of farm buildings. The basic details, 18 cross-sectional combinations, and 3 complete building plans are shown.

Multicombination pole-type construction gets its name from the fact that the few standard, detailed parts can be assembled into many combinations of buildings. Other features include: installment building, use of rigid-pillar construction, low-grade lumber, many types of roofing and wall materials, strong joints, and easy, economical assembly.

(Continued on page 712)

NEW BULLETINS

(Continued from page 710)

Changes in the Seasonal Patterns of Marketings, Prices, and Average Weights of Kentucky Spring Lambs, by C. D. Phillips and James L. Pearson. Kentucky Agricultural Experiment Station (Lexington), Bulletin 641 (March, 1956).

The 23-page bulletin reports a study covering the 21-year period, 1932 through 1952, in which the seasonal patterns of average weights, marketings, and prices of spring lambs marketed in Central Kentucky were examined in order to find out if significant changes have occurred. Data on these changes are presented to help the farmer to plan his sheep enterprise so as to finish lambs at the time and weight to insure the greatest average profit.

Methods and Tools for Tobacco Cultivation, by R. W. Wilson. Agricultural Experiment Station, North Carolina State College, (Raleigh). Bulletin 397 (March, 1956). The bulletin reports that, although replacement of the mule and hand labor by efficient methods and tools has been slow in tobacco cultivation, properly used tractors with rotary hoes, sweeps and tobacco hillers, which are now available, can nearly eliminate hoe hands.

The 15-page pamphlet contains charts and pictures to show the effects of cultivation as found from experiments carried out on the three types of soil commonly found in tobacco areas. Treatments ranged from no cultivation to high layby and tools included rotary hoes, sweeps, half-sweeps, scrapers and hilling disks. Results were graphed to indicate comparative rates per acre.

Copies of this bulletin may be obtained by writing to the experiment station.

Proceedings of the 53rd Annual Convention of the Association of Southern Agricultural Workers. This 214-page book contains abstracts of the papers presented at the 53rd annual convention of the association held in Atlanta, Ga., in February, 1956. A brief report of the meeting, the membership list of the association and a list of the officers, board of directors and section officers elected for 1956-57 are included.

General Education in Engineering by The American Society of Engineering Education. The 122-page paper bound book is a report of the humanistic-social research project which was financed by a grant from the Carnegie Corporation of New York to ASEE.

The study confines itself chiefly to the practical problems that confront those who plan, initiate, and maintain humanistic-social programs for engineering students. The appendices to the report contain information about the content and operation of representative existing programs. The body of the report consists of discussions — and where appropriate, recommendations — concerning the problems most often raised by those interviewed by field workers.

This investigation has made the Committee conscious of variations in facilities, aims, and potentialities among engineering schools, and one of its recommendations is that each institution take steps to plan a program appropriate to its own needs. The report states that there is no standardized pattern, at the present time, that is available for mass distribution. However, certain observations and recommendations seem to have some general validity, and these are summarized in the study.

NEW BOOKS

Rural Water Supply and Sanitation (Second Edition) by Forrest B. Wright. Cloth, 5½ x 8½ inches, xvi + 347 pages. Illustrated and indexed. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. $4.96.

For this edition the book has been almost entirely rewritten. New subject matter and new illustrations have been added to bring the book up to date. It is the author's aim to include as many of the new and important developments in the field of water supply and sewage disposal as space allows.

The book is divided into two parts. The important aspects of water supply and sewage disposal for the rural home and farmstead are discussed in the first part. Emphasis is placed upon methods of securing adequate source of water, the selection and installation of pumping equipment, treatment of water where necessary, the design and installation of supply plumbing systems, and the design and installation of sanitary sewage disposal systems. The second part of the book consists of a selection of jobs connected with water supply and sewage disposal, for the laboratory and for field work. These jobs are practical and have been selected as guides for anyone who wishes to plan or actually install water supply or sewage disposal equipment.

Irrigation Engineering, Volume II, by Ivan E. Houk. Cloth, ix + 531 pages, 6x9 inches. Illustrated and indexed. John Wiley & Sons, Inc., 440-4th Ave., New York 16, N. Y. $14.00.

Information for this book has been drawn from federal irrigation projects, officials in the Bureau of Reclamation, journal articles, and the author's own experience. The book reports engineering information on all aspects of irrigation projects, conduits, and dams.

Emphasis is on the practical requirements for evaluating irrigation feasibilities and in planning and constructing irrigation projects. Along with Volume I, which covers agricultural and hydrological phases, the book gives a picture of modern irrigation engineering. It gathers together information scattered throughout technical articles. Crop investment, crop production costs, land and water studies, and canal structures are all incorporated in the full irrigation picture.

A chapter is written for each of the following: project feasibility, project planning, lands, water, conveyance, canals and ditches, linings, flumes, pipes, tunnels, control structures, protective structures, diversion dams, storage dams, spillways, gates and valves, and fish protection.

Applied Animal Nutrition, by E. W. Crampton. Cloth, 5½ x 8½ inches, xx + 458 pages. Illustrated and indexed. W. H. Freeman and Company, 660 Market St., San Francisco 4, Calif. $6.50

This book is concerned with the application of scientific knowledge to the everyday feeding of livestock. The author feels that the teaching of animal nutrition should bring the theory of nutrition and the practice of animal feeding closer together. The book has been written to help bridge the gap between animal nutrition and livestock feeding practice.

There are four main sections, plus an appendix. The first section is devoted to the definition and appraisal of terms used in describing feedstuffs. Section II deals with nutritional requirements of animals and gives special attention to the biological basis for feeding standard data. Section III consists of a discussion of the nutritional characteristics of some common feeds. A classification of roughages according to available energy is included. The final section deals with the problems of ration formulation. Comments on feed legislation and a table of feed composition appear as an appendix.

Abacs or Nomograms by A. Giet. Translated and revised by J. W. Head and H. D. Phippen. Cloth, 5½ x 8½ inches, ix + 225 pages. Illustrated and indexed. Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. $12.00.

This edition, which has been adapted for English readers, will be of interest to engineers and physicists, and others who require time-saving methods when performing repetitive and complicated calculations. It is practical, and not only demonstrates the varied applications of the abac or nomogram, but shows how even those without specialized mathematical knowledge may construct their own charts. The book deals with both Cartesian abacs and alignment charts, and contains a number of practical examples drawn from the fields of mechanics, physics and electrical engineering.

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Beck, Raymond A.—St. Elizabeth, Mo.

Blaisdell, John L.—Graduate student (Mail) University of Massachusetts, Farmhouse, Amherst, Mass.

Blaskey, Merrill L.—Junior engineer, Northern States Power Co. (Mail) 15 S. 5th St., Minneapolis 2, Minn.

Carleton, William A.—State sales manager, Armco Drainage & Metal Products, Inc. (Mail) P.O. Box 266, Lansing, Mich.

Challenger, George V.—Supervisor of farm services, B. C. Electric, Box 670, Abbotsford, B. C., Canada

Chant, Lonnie R. — Plant engineer, United Concrete Pipe Corp., P.O. Box 10283, Industrial Station, Dallas, Tex.

Corr, Harry E. — Motor Officer, Co. B., 802nd Engineers Bn (heavy const.) APO 929, San Francisco, Calif.

Denneler, Daniel R. — Project engineer (SCS) USDA, Lincoln, Kans.

Dull, Arthur G. — Drainage contractor (Mail) RR 1, Beaverton, Mich.

Eichman, A. S.—Assistant district manager, Timken Roller Bearing Co., 2534 So. Michigan Ave., Chicago 16, Ill.

George, John E. Jr. Assistant professor and assistant engineer, dept. of agric. eng., State College of Washington (Mail) 412 State St., Pullman, Wash.

Harter, James G. — Farm engineer, King Farms Company (Mail) RR 1, Ford Mill Road, Morrisville, Pa.

Honeyfield, Harold R. — Graduate assistant in agr. eng., Purdue Univ., Lafayette, Ind.

Karim, Mansour — Instrument man, South Dakota Highways Dept. (Mail) State Highway Dept.

Kiltz, Burton F.—Chief of land management branch, buildings and grounds division, Office of the Chief of Engineers, Dept. of the Army, Washington 25, D. C.

Kiratsous, Athanasios — Student in food technology and instructor in agricultural engineering, Univ. of Mass. (Mail) 99 E. Pleasant St., Amherst, Mass.

Maxon, Vernon A. — Junion engineer, John Deere Harvester Works (Mail) Engr. Dept. John Deere Harvester Works, E. Moline, Ill.

McVey, John L. — Assistant agricultural engineer, Mississippi Agricultural Extension Service, State College, Miss.

Mesen, Rodrigo A.—C.N.P. representative, Consejo Nacional de Produccion (Mail) Zapot de S. Jose, Costa Rica, Central America

Morrow, Richard J. — Sales trainee, John Deere Planter Works (Mail) Keosaugua, Iowa

Mulligan, Clarence W.—Research associate, dept. of agr. eng., Cornell University (Mail) Riley-Robb Hall, Cornell University, Ithaca, N.Y.

Myll, Clifton O.—General Manager, Co-Vol Concrete Pipe Co., (Mail) P.O. Box 116, Coachella, Calif.

Neumann, Henry D. — Hydraulic engineer, U. S. Bureau of Reclamation (Mail) Box 1018, Quincy, Wash.

Nolte, Byron H. — Agricultural engineer, (SCS) USDA (Mail) Higginsville, Mo.

Peabody, Reo L.—Engineering aid, (SCS) USDA (Mail) RR 1, Sears, Mich.

Reece, Floyd N. — Extension agricultural engineer, Kansas State College, Manhattan, Kans.

Roven, Kenneth A.—Construction engineer, Corps of Engineers, U. S. Army (Mail) 4013 Chestnut, Kansas City, Mo.

Saunders, David T. — Vice-president and training program director, Tractor Training Service, Portland 4, Ore.

Saunders, Peter—Designer-engineer (Mail) 24 Upper Road, Foster Clark Estate, Maidstone, Kent, England

Sawyer, Fred D. — Supervisor, implement section service department, Ford Tractor & Implement Div., 2500 E. Maple Rd., Birmingham, Mich.

Schreiber, Wilbur F.—Chief draftsman, Ford Motor Co., Tractor and Implement Div., 2500 E. Maple Rd., Birmingham, Mich.

Schweitzer, Shmuel—Agricultural engineer, Israel Institute of farm machinery (Mail) c/o Trembsky, Zlotopolsky Street 16, Tel-Aviv, Israel

Strever, John L. — Arcadia Food Producers Corp. (Mail) Box 108, Caledonia, Mo.

Trustdorf, John H.—Work unit conservationist, Soil Conservation Service, 846 N. Pine St., Evart, Mich.

Van Duyne, Daniel A.—Ensign, U. S. Navy, Naval Air Reserve Training Unit (Mail) Jacksonville Road, Towaco, N. J.

Wang, Jaw-kai—Graduate assistant, Dept. of Agr. Engr. Michigan State University, East Lansing, Mich.

Weinblum, Mordechai — Agricultural engineer, Israel Institute of Technology (Mail) Givat Nesher, Haifa, Israel

Zastrow, Virgil A. — Engineering trainee, Caterpillar Tractor Co. (Mail) 121 Illinois Ave., Morton, Ill.

Transfer of Membership Grade

Dimick, Niel A.—Agricultural engineer, U.S. Experiment Station, Newell Irrigation and Dry Land Field Sta., Newell, S. Dak. (Associate to Member)

(Continued on page 718)

PERSONNEL SERVICE BULLETIN

NOTE: In this bulletin the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated. "Agricultural Engineer" as used in these listings is not intended to imply any specific level of proficiency or registration as a professional engineer. Items published herein are summaries of mimeographed listings carried in the Personnel Service, copies of which will be furnished on request. To be listed in this Bulletin, request form for Personnel Service listing.

POSITIONS OPEN — JANUARY — O-534-790. FEBRUARY—O-4-602, 6-603, 29-606. MARCH —O-60-608, 60-609, 71-611, 80-612. APRIL—O-115-614, 117-615, 117-616, 119-617. MAY—O-133-620, 155-621. JUNE—O-165-623, 166-624, 166-625, 167-626, 159-627, 175-630, 179-631, 181-632 181-633. JULY—O-183-634, 180-636, 198-637, 215-638, 216-639. AUGUST — O-233-640, 234-641, 217-643, 239-644, 240-645, 241-646, 244-F47, 262-648, 246-649. SEPTEMBER—O-271-650, 305-651, 307-652, 292-653, 314-654.

POSITIONS WANTED — JANUARY — W-457-60, 528-61. FEBRUARY—W-8-1, 18-5, 30-6, 37-7. APRIL—W-50-11, 96-14, 43-15, 53-16. MAY—W-125-17, 139-18, 143-19. JUNE — W-161-20. JULY—W-190-23, 214-25. AUGUST—W-283-26. SEPTEMBER—W-284-27, 308-29, 359-30.

NEW POSITIONS OPEN

AGRICULTURAL ENGINEER or related training for power use advisor in Washington Rural Electric Cooperative serving 3500 members. Diversified agricultural area with favorable power rate. Good schools, pleasant living in city of 3500. Salary open. O-330-655

MECHANICAL ENGINEER for design and development work on food processing equipment with nationally known organization of food processors. Midwest. Age 24-32. Graduate mechanical or agricultural engineer. Outstanding opportunity offering exceptional future with progressive organization. Unusual employee benefits. Salary open. O-316-656.

NEW POSITIONS WANTED

AGRICULTURAL ENGINEER for sales, service, or management in power and machinery with manufacturer, distributor, or farming operation, anywhere in USA. Married. Age 26. No disability. BS deg in agricultural engineering, University of Maine, 1951. Experience in own potato and beef farming operation, 3 yr. On duty with Army as a personnel management specialist. Due for release in January. Available February 1. Salary open. W-315-31

AGRICULTURAL ENGINEER for extension, sales, service, or management in power and machinery or rural electric field with college, distributor, or consultant, in Southwest or Midwest. Married. Age 41. No disability. BS deg in agricultural engineering, Texas A & M College, 1942. Farm background. Public relations work for electric utility with teachers and county agents, 4 yr; division sales manager, 3 yr; manager of agricultural development, 3 yr. War commissioned service with 5th Armored Division and military government. Available now. Salary open. W-323-33

AGRICULTURAL ENGINEER for design, development, research or teaching in rural electric or product processing field, with college, manufacturer or processor, preferably in the Midwest. Married. Age 33. No disability. BS deg, 1950; MS deg expected December 1956, both in agricultural engineering at Michigan State College. Precollege experience, 3 yr as turret lathe operator. Farm service advisor with electric utility, 5 yr. Graduate assistant, research and teaching while working on MS. War non-commissioned service in meteorological section, USAAF, over 3 yr; postwar commissioned service in communications section, USAF, 16 mo. Available January 1. Salary open. W-328-34

AGRICULTURAL ENGINEER for design, development, sales, writing or management, preferably in power and machinery field, with manufacturer, anywhere in USA. Will travel. Married. Age 42. No disability. AB, Hope College, 1937. Some graduate study in education and administration. Teacher and principal, 9 yr. Manager of celery growers cooperative, 2 yr. Sales, 2 yr, and designer and production manager, 7 yr, with manufacturer of automatic poultry feeding and watering equipment, with advancement to vice-president. Designed most equipment in leading line in this field, including 3 distinct mechanical feeder chains. Numerous patents granted and pending. Successful direction of company growth to $3,000,000 volume in 7 yr. Available now. W-332-35

Applicants for Membership

(Continued from page 716)

Evans, Norman A.—Associate professor and associate agricultural engineer, Colorado A & M College, Fort Collins, Colo. (Associate to Member)

Garton, James E. — Associate professor, Oklahoma A & M College, Stillwater, Okla. (Associate to Member)

Jacob, Frederick C. — Associate specialist, Dept. of agr. eng., University of Calif., Davis, Calif. (Associate to Member)

Jennings, Norman R.—Manager, engineering division, Pennsylvania Farm Bureau Cooperative Assn. (Mail) P.O. Box 23, Harrisburg, Pa. (Associate to Member)

Kimbrough, E. A. Jr. — Assistant professor and assistant agricultural engineer, Mississippi State College and Agr. Experiment Sta. (Mail) Box 432, State College, Miss. (Affiliate to Associate)

Levine, Gilbert — Assistant professor, Agr. Eng. Dept., Riley-Robb Hall, Cornell University, Ithaca, N. Y. (Associate to Member)

Smith, Charles A.—Field test engineer, New Holland Machine Co. (Mail) 227 Wecaf St., New Holland, Pa. (Affiliate to Associate)

Strautman, Arthur J.—Farm service engineer, Imperial Oil Limited, Marketing Div. 102 St. & 100 Ave., Edmonton, Alta. Canada. (Associate to Member)

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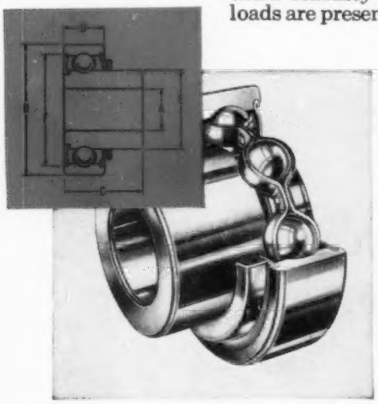

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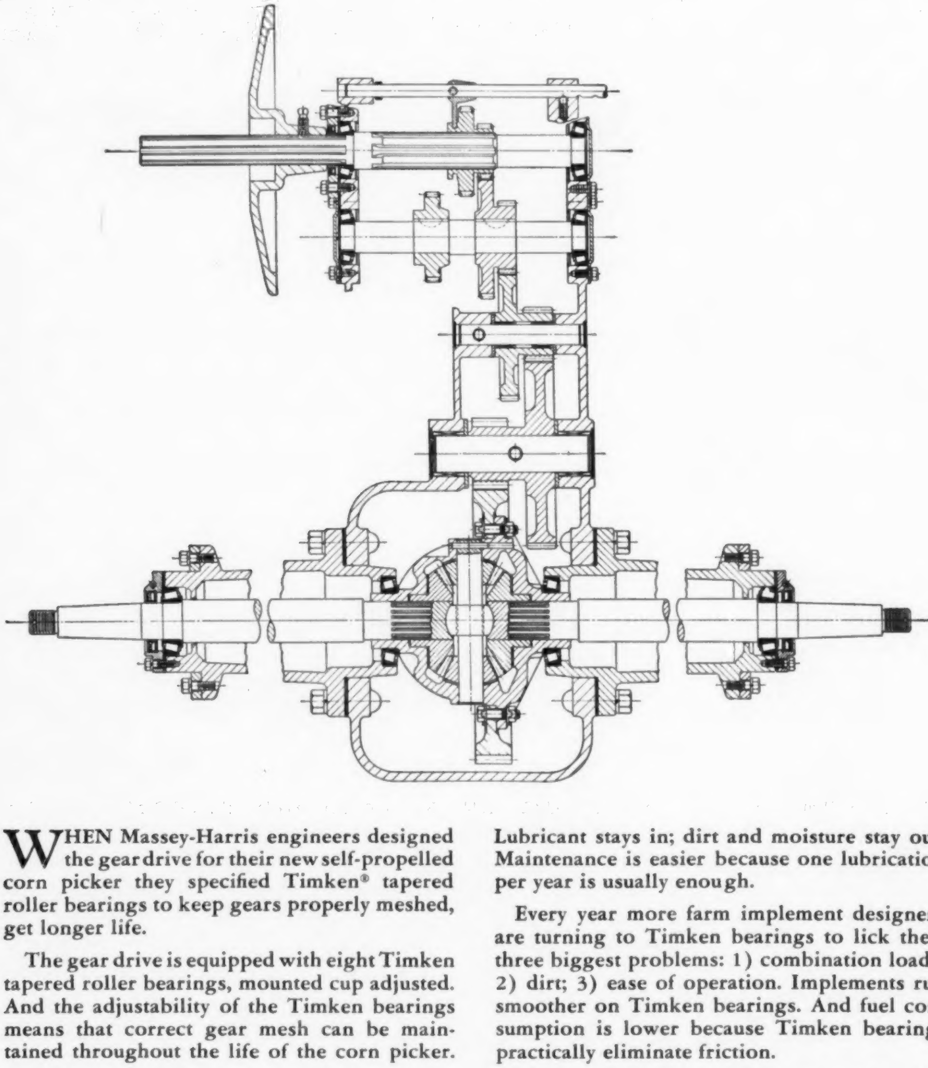

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